

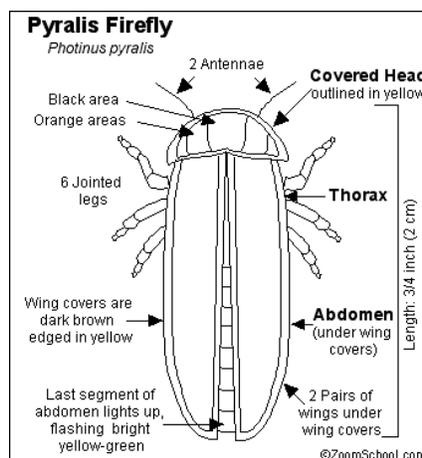
FIREFLIES

Taxonomy

Family: Scientifically, fireflies are classified under Lampyridae, a family of insects within the beetle order Coleoptera, or winged beetles. While most fireflies are characterized by their use of bioluminescence to attract mates and communicate with others in their species, not all insects within the firefly family produce light. Some communicate using pheromones, a sort of insect perfume. The whole family, some 2,000 species, covers much of the temperate and tropical world. The greatest numbers of firefly species (highest species diversity) are found in tropical Asia and Central and South America.

Subfamilies

Photurinae: This family includes the most common North American fireflies. Not all fireflies in this subfamily light up, but those that do are generally divided into three closely related species. The most familiar species of firefly in Tennessee is *Photinus pyralis*.



Photinus fireflies tend to be the most common of this group. They are about half an inch long and produce a yellow-green light.

Photuris fireflies are larger—almost an inch long—and produce a darker green light. Female *Photuris* often mimic mating flashes from female *Photinus* fireflies to attract and eat *Photinus* males. Because of this, *Photuris* species are sometimes called “femme fatale” fireflies.

Pyroactomena fireflies produce a yellow-amber flicker that looks a bit like a spark from a campfire.

Other Families

- **Luciolinae** is the largest subfamily of fireflies with member species scattered throughout Eurasia, Europe, East Asia, and Australia. The fireflies within this subfamily all produce light—and flash rather than emit a continuous glow.
- **Cyphonocerinae** fireflies include two genera that live in North America and Eurasia. Considered the most primitive species of fireflies in existence, one genus within this group displays very weak light and the other does not light up at all.
- **Lampyrinae** are a group of fireflies that do not fit into other groups. These species live generally in more temperate northern regions of the world. The group contains both flashing and continuous-glow fireflies

- **Otetrinae** fireflies share many characteristics of other firefly species, but they do not emit light and are considered the most primitive. They live primarily in Eurasia and North America.

Range: Fireflies live on all the continents except Antarctica. Loving humid areas, they thrive in tropical regions. In temperate zones they come out in the summertime. A few species, however, are found in arid regions. Although some isolated sightings of luminous fireflies have been reported from time to time from regions of the western U.S., fireflies that glow are typically not found west of Kansas. The reason for this phenomenon is not known.

Habitat: Fireflies thrive in forests, fields and marshes near lakes, rivers, ponds, streams and vernal pools. Most firefly larvae are found in rotting wood or other forest litter or on the edges of streams and ponds at night. They need a moist environment to survive. Some species of firefly larvae are generally aquatic—they even have gills—while others live almost entirely in trees. Adult fireflies are found in the same general habitats as their larvae.

Short Lifespan: The larvae usually live for approximately one year, from mating season to mating season, before becoming adults and giving birth to the next generation. Adults live only about 21 days, living long enough to mate and lay eggs.

Diet:

- Larvae are predaceous and have been observed feeding mostly on earthworms, snails and slugs. Larvae can detect a snail or slug slime trail, and follow it to the prey. After locating their future meal, they inject an anesthetic type substance through hollow ducts in the firefly's mandibles into their prey in order to immobilize and eventually digest it. Multiple larvae have also been observed attacking large prey items, such as large earthworms. Other observations suggest larvae sometimes scavenge dead snails, worms and similar organic matter.
- Adults also have mouth parts suggestive of predation (long sickle-shaped mandibles). Although it is widely known that fireflies of a few species mimic the mates of other species in order to attract and devour them, observations of adults feeding on other prey items are practically non-existent. Adults might feed on plant nectar in order to sustain their energy requirements in the adult stage.

Defenses: When attacked, fireflies shed drops of blood in a process known as “reflex bleeding.” The blood contains chemicals that taste bitter and can be poisonous to some animals. Because of this, many animals learn to avoid eating fireflies.

Nocturnal: Fireflies are nocturnal, and during the day they spend most of their time on the ground. At night, they crawl to the tops of blades of grass and fly into tree branches to signal for mates. Long grass conceals the fireflies better and allows them a better vantage point for signaling at night.

Bioluminescence

Most but not all adults of firefly species are bioluminescent. However, all known firefly larvae are bioluminescent, as are some firefly eggs. Also not all bioluminescent beetles are fireflies. Related beetle families that have bioluminescent members include some click beetles (family Elateridae), phengodid beetles (family Phengodidae), and several other very small families.

Larvae and Eggs: All known firefly larvae have photic organs that produce light. In some species, even the eggs emit light. Firefly eggs have been observed to flash in response to stimulus such as gentle tapping or vibrations. The most generally accepted hypothesis is firefly larvae use their luminescence as a warning signal that communicates to potential predators that

they taste bad because they have defensive chemicals in their bodies. These larvae also increase both the intensity and frequency of their glow when disturbed.

Light Production: The firefly produces light through an efficient chemical reaction using special photic organs with very little heat given off as wasted energy. Fireflies produce light via a chemical reaction consisting of Luciferin (a substrate) combined with Luciferase (an enzyme), ATP (adenosine triphosphate) and oxygen. When these components are added, light is produced. While we have several theories on how fireflies control the "on" and "off" of their photic organs, the exact mechanism has yet to be worked out.

100% Efficient: Firefly lights are the most efficient lights in the world—100% of the energy is emitted as light. Compare that to an incandescent bulb which emits 10% of its energy as light and the rest as heat, or a fluorescent bulb which emits 90% of its energy as light. Because it produces no heat, scientists refer to firefly lights as “cold lights.”

Our Understanding of the Purposes of the Firefly Glow

Mating: In most North American species of firefly, the males fly about flashing their species-specific flash pattern while females are typically perched on vegetation near the ground. When a flashing male attracts a female, she responds at a fixed time delay after the male's last flash. A short flash dialogue may ensue between the fireflies as the male firefly locates her position and descends to mate. These bioluminescent signals can take the form of anything from a continuous glow, to discrete single flashes, to "flash-trains" composed of multi-pulsed flashes

Warning: Some experts think the firefly's flashy style may tell predators, “Buzz off! I don't taste very good!” But some frogs eat fireflies, anyway. Some eat so many fireflies that the frogs themselves may begin to glow.

Aggressive Mimicry is a phenomenon where one organism (a mimic) tricks another organism (the dupe) into thinking it is another (the model), with the result being a negative outcome for the dupe, as well as the model. In the case of aggressive mimicry in fireflies, mated females that belong to a few species in the genus *Photuris* mimic the female responses of other fireflies in the same area in order to attract males of the mimicked species. When these males are tricked into landing near these mimics to mate, they are pounced upon and eaten. Recent evidence also suggests that these female mimics are not only acquiring food but also defensive chemicals from their prey which they themselves do not produce in large quantities.

Even more interesting, scientists believe some *photinus* males imitate *Photuris* females giving off bad impressions of *Photinus* male flashes, scaring off other *Photinus* males and reducing competition.

Synchronous: Thousands of fireflies will blink in perfect unison for minutes or hours at a time. Only certain species do it, and they only do it some of the time. Called “synchronicity,” it is a phenomenon yet to be fully understood. Synchronous fireflies (*Photinus carolinus*) are one of 14 species of fireflies that live in Great Smoky Mountains National Park. They are the only species in the Americas whose individuals can synchronize their flashing light patterns.

No one is sure why the fireflies flash synchronously. Competition between males may be one reason: they all want to be the first to flash. Or perhaps if the males all flash together they have a better chance of being noticed, and the females can make better comparisons. The fireflies do not always flash in unison. They may flash in waves across hillsides and at other times will flash randomly. Synchrony occurs in short bursts that end with abrupt periods of darkness.

Threats to Fireflies

Declining numbers: Anecdotal evidence suggests firefly populations are dwindling; in some areas they have declined dramatically.

Loss of habitat: Fireflies thrive in open fields and forests. As their habitat disappears under housing and commercial developments and logging, firefly numbers dwindle.

Light pollution: Both male and female fireflies use their flashing lights to communicate. Fireflies typically will not make an appearance where there are bright ambient lights, such as full moon evenings. Human light pollution is believed to interrupt firefly flash patterns. Along with increased development comes increased artificial illumination at night. In rural areas where the only night lights once came from the moon and stars, suburban sprawl has brought extensive exterior lighting along roads, in private yards, and in commercial centers. It can be so bright that residents can no longer see the stars at night.

Scientists have observed that synchronous fireflies get out of synch for a few minutes after a car's headlights pass. Light from homes, cars, stores, and streetlights may all make it difficult for fireflies to signal each other during mating—meaning fewer firefly larvae are born next season. Where fireflies once had dark forests and fields to live and mate, homes with landscaped lawns and lots of exterior lights are taking over.

Pesticides: Chemical pesticides and weed killers may also have a negative effect on firefly populations. Fireflies and their larvae may come into contact with other insects that have been poisoned, or they may ingest the poisons from plants that have been sprayed.

Attracting Fireflies to your Yard or Garden

1. Cut down or eliminate using chemicals on you lawn and pesticides.
2. Reduce any "extra lighting" (photic noise) on your property. Most fireflies find a mate by flashing. They must be able to see the flash of a prospective mate and return the flash.
3. Additionally, low overhanging trees, tall grass or similar vegetation will provide adult fireflies a place to rest during the day and remain cool. Some species of firefly larvae grow up in rotten logs and the litter that accumulates beneath the forest canopy. If you have trees in your yard, consider leaving some natural litter around them to give firefly larvae a place to grow.
4. Most species of fireflies have one thing in common: they thrive around standing water and marshy areas. Ponds, streams and rivers can all provide good habitats for fireflies, but even a small depression full of water can cause them to congregate.
5. Let the grass grow. Fireflies mainly stay on the ground during the day, and frequent mowing may disturb local firefly populations. While you may feel that you need to keep your lawn mowed for aesthetic purposes, consider incorporating some areas of long grasses into your landscaping. Fireflies prefer to live in long grasses, and doing this may boost their population in your yard.

The Obed Watershed Community Association has as its purpose the protection and enhancement of the natural and cultural heritage of the Obed River watershed within Cumberland County. Louise Gorenflo, OWCA community educator, produced this fact sheet. Those wanting to join this membership organization or more information may contact Dennis Gregg, OWCA Director at 484-9033 or at 185 Hood Drive, Crossville, TN 38555.