

## Definition and Cycle of Diptera

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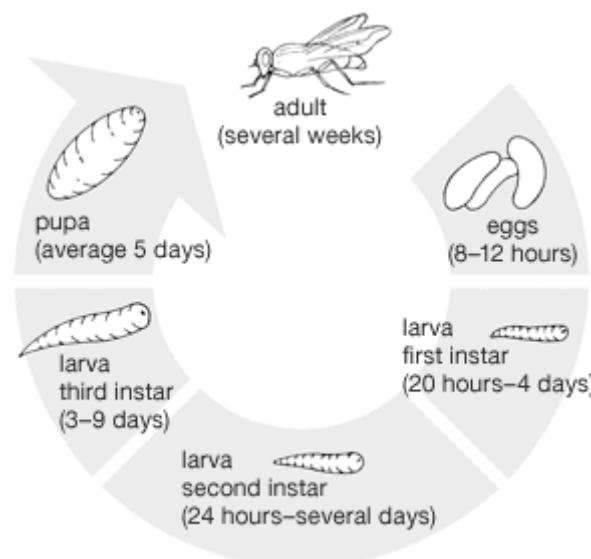
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**Annotation.** The life cycle of a fly consists of four stages: egg, larva, pupa, and adult. Since larval forms, always morphologically distinct from adults, also occupy different habitats, flies in effect live two distinct lives and thus are able to adapt successfully to environmental changes. In some flies (e.g., robber flies) neither the larval nor the adult stage predominates; the larva feeds actively in soil, and adult flies of both sexes catch other insects in flight. Among mosquitoes, black flies, and related bloodsucking flies, the larvae have characteristic structures and live active lives under water; the complex mating process of the adults is followed (in the case of females) by bloodsucking and egg laying.

**Keywords.** Diptera, Fly, egg, larva, pupa, adult, morphologically.

Dipteran, (order Diptera), any member of an order of insects containing the two-winged or so-called true flies. Although many winged insects are commonly called flies, the name is strictly applicable only to members of Diptera. One of the largest insect orders, it numbers more than 125,000 species that are relatively small, with soft bodies. Although the mouthparts of flies are of the sucking type, individuals show considerable variation in structure. Many flies are of great economic importance. Some bloodsuckers are serious pests of humans and other animals. These insects, along with many scavenging flies, are important vectors of disease, whereas others are pests of cultivated plants. Flies are beneficial, too, functioning as scavengers, predators, or parasites of certain insect pests, as pollinators of plants, and as destroyers of weeds noxious to humans. Dipterous larvae, often called maggots or grubs, are found in many habitats (e.g., in any kind of water, in plant tissue and soil, beneath bark or stones, in decaying plant and animal matter, even in pools of crude petroleum). Adults feed on plant or animal juices or other insects. Diptera fall into three large groups: Nematocera (e.g., crane flies, midges, gnats, mosquitoes), Brachycera (e.g., horse flies, robber flies, bee flies), and Cyclorrhapha (e.g., flies that breed in vegetable or animal material, both living and dead). Flies range in size from midges of little more than 1 mm to robber flies more than 7 cm long. In general, the more-primitive flies (e.g., mosquitoes, midges, fungus gnats) are fragile insects with delicate wings. The more-advanced flies (e.g., blow flies, houseflies) are generally squat, sturdy, and bristly. They are stronger fliers than midges and gnats. Diptera are abundant throughout the world: in the tropics, in the subarctic, at sea level, and high on mountains. They colonize beaches to low-tide level, but few go into deeper water, and only one or two midges are truly marine (e.g., *Pontomyia natans* in the Pacific). On the other hand, migrating flies have been found far out to sea. The abundance, worldwide distribution, and habits of flies combine to make them a nuisance to humans. Swarms of midges are a common annoyance. Sweat flies and face flies gather around the eyes, nose, and mouth and also suck blood and pus from wounds and sores. Such flies move constantly from one person to the next and in so doing may at times transfer disease-causing organisms. The housefly (*Musca domestica*) can be dangerous because it moves from person to food, drink, garbage, carrion, or feces. By transferring infective organisms from decomposing material or from infected people, houseflies are agents in transmitting typhoid, dysentery, cholera, summer diarrhea in children, and other intestinal virus- and bacteria-caused diseases. Eye gnats are a nuisance in warm countries. Although the larvae are plant feeders, the small active adults feed on physiological secretions, particularly those around the eyes. Other flies pierce the skin of vertebrates and feed on their blood. Mosquitoes, black flies, sand flies, biting midges, and horse flies have evolved mandibles and maxillae that are bladelike, piercing stylets. These piercing organs are developed only in females, which use blood protein in egg production. Males do not feed on blood.



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Other groups of flies have evolved different mechanisms for obtaining blood. Tsetse flies, stable flies or biting houseflies (*Stomoxys*), and certain parasitic flies have developed a hard drill-like labium to replace the soft spongelike one. Both males and females have evolved this labium and both feed on blood. A few flies related to the housefly have a spongy proboscis equipped with small teeth for rasping skin around wounds and sores to increase the flow of blood and lymph. Other groups (e.g., robber flies) have developed a piercing proboscis used only against other insects. The transmission of disease that occurs through the use of piercing organs such as a proboscis is considered mechanical transmission. Disease-causing organisms in the blood can be picked up by a fly inserting its proboscis into an infected person. The disease may then be transmitted to another person when their skin is pierced by the bloodsucking fly, which injects its saliva into the wound. Without the anticoagulant properties of this saliva, bloodsucking would be impossible since the tiny hole drilled by the proboscis would clog with clotted blood. If the mouthparts are contaminated with blood that contains microorganisms, they can be injected, along with the saliva, into another person. This is called direct transmission of disease and occurs only if the fly, interrupted during a meal, finds a new victim before the microorganisms die. One contagious disease that might be spread this way is tularemia, caused by a bacterium found in wild rodents. Trappers who cut themselves while skinning animals can contract the disease. In North America the bacterium is transmitted also by the deer fly (*Chrysops discalis*), common in wooded trapper country. Surra, a disease of horses and camels in the Middle East and parts of Asia, is caused by the protozoan *Trypanosoma evansi* and is transmitted by horse flies. Trypanosomes, transmitted by tsetse flies, cause sleeping sickness in humans and nagana in animals throughout tropical Africa. These trypanosomes must spend part of their life cycle in the insect before they can infect a vertebrate. This is an example of cyclic disease transmission. The relationship between the parasitic disease organism and its two hosts, vertebrate and insect, is a result of evolutionary adaptation. However, it is not known whether the trypanosome was originally a fly parasite that spread to humans and other vertebrates or whether it was a human parasite that became adapted to living in a biting fly. An important cyclically transmitted disease is malaria. Plasmodium, the causative agent of human malaria, is an acellular protist nourished by red blood cells in human blood. Its reproductive cycles cause recurrent bouts of the disease. Occasionally sexual forms occur in the victim's blood. If this form finds its way into a suitable species of bloodsucking mosquito, another stage of the Plasmodium begins, preparing the organism to infect another human bitten by the mosquito host.



Other diseases known to be cyclically transmitted include yellow fever, filariasis, encephalitis, and other viral diseases. Fly larvae are serious agricultural pests; they feed on young crop plants, retarding growth or killing them. Cultivated crops, because they provide pests with an almost unlimited food supply within a small area, can be devastated by uncontrolled population growth of a pest. On the other hand, wild food plants, because they are scattered and mixed with other varieties, do not usually provide so abundant a food supply and thus serve as a check on population growth. Frit flies can cause a 20 percent loss of an oat crop, and to the value of the lost oats must be added the cost of control measures necessary to save the remainder. Some crops, notably fruit trees and ornamental shrubs, are a financial loss if slightly disfigured by insect attack, though the life of the plant is not endangered. Fruit, although edible after attack by Mediterranean fruit flies, cannot be sold; a few infested fruits can result in loss of an entire consignment. Larvae of gall midges and leaf miners lower the commercial value of ornamental plants.

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