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## **Insects**



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## Introduction

With around one million named species and perhaps several times that number unnamed, insects account for a great majority of the species of animals on earth. They are a tremendously successful group. Insects can be found in almost all terrestrial and freshwater habitats, from the driest deserts to freshwater ponds, from the canopy of a tropical rainforest (where their diversity is unbelievably great) to the arctic wastes. A few species are even marine. Their feeding habits are similarly varied; almost any substance that has nutritive value is eaten by some group of insects.

Insects also show huge variety in shape and form. Almost the only condition their group does not attain is very large body size. A number of features, however, are shared by most kinds of living insects. In addition to the general characteristics of uniramians, these include a body composed of three tagmata, a head, thorax, and abodmen; a pair of relatively large compound eyes and usually three ocelli located on the head; a pair of antennae, also on the head; mouthparts consisting of a labrum, a pair of mandibles, a pair of maxillae, a labium, and a tonguelike hypopharynx; two pairs of wings, derived from outgrowths of the body wall (unlike any vertebrate wings); and three pairs of walking legs.

Insects have a complete and complex digestive tract. Their mouthparts are especially variable, often complexly related to their feeding habits. Insects "breathe" through a tracheal system, with external openings called spiracles and increasingly finely branched tubules that carry gases right to the metabolizing tissues. Aquatic forms may exchange gases through the body wall or they may have various kinds of gills. Excretion of nitrogenous waste takes place through Malpighian tubules. The nervous system of insects is complex, including a number of ganglia and a ventral, double nerve cord. The ganglia are largely independent in their functioning; for example, an isolated thorax is capable of walking. Yet ganglia also use sensory output. A grasshopper with one wing removed can correct for this loss and maintain flight, using sensory input from its brain. Sense organs are complex and acute. In addition to ocelli and compound eyes, some insects are quite sensitive to sounds, and their chemoreceptive abilities are astounding.

Insects are dioecious and fertilization is internal in most. The ways in which mating is accomplished, however, are incredibly variable; study of this variability by evolutionary biologists has greatly advanced our understanding of the evolution of behavior, social evolution, and traits such as number, size of young and patterns of investment in them. Reproduction by insects often involves a male locating a receptive female through chemicals (pheromones) released by the female. In most species, females store the sperm in a special receptacle in their abdomens; even species that lay huge numbers of eggs (in honeybees, for example, the number may be over one million), females mate only once and rely on sperm stored during that mating for the rest of their lives.

The manner in which growth is accomplished is an especially important characteristic of insects. In some, hatching eggs produce miniature adults, which to grow must shed their exoskeleton in a process called ecdyisis. In almost 90% of insect species, however, newly hatched young are completely different in appearance from adults. These larval forms usually live in different habitats, eat different foods, and assume a body form completely different from that of their parents. The larva feeds and grows, molting its skin periodically. At some point larval growth is completed, the larva stops feeding and builds a case or cocoon around itself. In this nonfeeding condition it is called a pupa or chrysalis. While so encased, the larva undergoes a complete transformation or "metamorphosis" of its body form, and a fully-formed adult emerges. Insects that experience this sort of complete change are called "holometabolous." Other species undergo a more gradual process, in which the newly hatched young are more similar to the adult but are small in size, lack wings, are sexually immature, and may differ in other, relatively minor ways as well. The young in these insects are called nymphs, and the lifestyle is referred to as "hemimetabolous."

Insects are incalculably valuable to man. Usually, we think of them in a negative context. Insects eat our food, feed on our blood and skin, contaminate our dwellings, and transmit horrible diseases. But without them, we could not exist. They are a fundamental part of our ecosystem. A brief and incomplete list of their positive roles would include the pollination of many, perhaps most higher plants; the decomposition of organic materials, facilitating the recycling of carbon, nitrogen, and other essential nutrients; the control of populations of harmful invertebrate species (including other insects); the direct production of certain foods (honey, for example); and the manufacture of useful products such as silk and shellac.

## References

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