A broad group of animals that include insects, crustaceans, and spiders; the largest animal phylum, with more 700,000 species.

Subphylum Trilobitomorpha
The trilobites comprise a wholly extinct group of primitive marine arthropods. They were extremely abundant in the Cambrian and Ordovician geologic periods, becoming extinct in the Permian. The flattened, oval body was composed of a head covered by a dorsal shield, a trunk (thorax), and a terminal segment (pygidium). Most of the 3,900 species ranged in length from 1 to 4 in. (2.5–10 cm); some planktonic forms were smaller, and some species were as long as 2 1/2 ft (76 cm). *Triarthrus eatoni* was a fossil trilobite common in the Ordovician seas.

Subphylum Chelicerata
Chelicerates are characterized by the absence of antennae and jaws and the presence of feeding structures (chelicera), which are modified pincerlike appendages used mainly for grasping and fragmenting food. They include spiders, scorpions, mites, ticks, and other arachnids (class Arachnida), horseshoe crabs (class Xiphosura), and the sea spiders (class Pycnogonida) as well as the extinct giant sea scorpions (class Eurypterida). The arachnids are largely terrestrial, and the other classes marine.

Mandibulata
The mandibulates, consisting of the subphyla Crustacea, Myriopoda (centipedes, millipedes, pauropods, and symphylans), Hexapoda (insects and their relatives) constitute the largest and most varied arthropod group and are characterized by the presence of modified appendages (mandibles) flanking the mouth and used as jaws.

Subphylum Crustacea

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The crustaceans are characterized by two pairs of antennae and two pairs of modified appendages (maxillae) used for food handling. There are over 40,000 species of crustaceans, including lobsters, shrimps, crayfish, crabs, copepods, barnacles, and a large number of minute planktonic forms. Crustaceans are the only arthropods that are mainly aquatic, and most of them are marine. Some have spread to humid areas near water. They use gills for respiration. The thoracic region typically bears walking legs (pereiopods), also used for capturing prey. The abdominal region often is equipped with swimmerets (pleopods) and a tail fan made up of a pair of appendages (uropods) and the telson. Their excretory organs are modified nephridia, as a rule producing a dilute urine that contains a great deal of ammonia.

Crustaceans are herbivores, carnivores, or scavengers and are often vital elements of the food chain. Some, such as lobsters, shrimp, and crayfish, are important economically as edible shellfish. Barnacles are notorious as fouling organisms of ship bottoms and harbor installations. Some crustaceans, such as the copepods known as sea lice, are significant parasites of other aquatic organisms. As a rule they pass through a complex set of molts during development, involving a series of larval stages. The characteristic larva is called a nauplius, with three pairs of appendages. More appendages are added as the organism passes through its developmental molts. The cuticle of crustaceans, unlike that of other arthropods, contains calcium deposits. The most familiar classes are the Branchiopoda, which includes the orders Notostraca (tadpole shrimps) and Diplostraca (clam shrimps and water fleas); the Malacostraca, which includes the orders Stomatopoda (mantis shrimps), Mysida (opossum shrimps), Isopoda (isopods), Amphipoda (amphipods), and Decapoda (crayfish, lobsters, shrimps, and crabs); and the Maxillopoda, which includes the order Copepoda (copepods) and the infraclass Cirripedia (barnacles).

**Class Chilopoda**

Class Chilopoda includes the 5,000 species of centipedes, all of which are terrestrial. Centipedes are carnivorous and predacious, immobilizing their prey, usually consisting of smaller arthropods, with the aid of their fangs. The body is composed of a head region bearing a pair of antennae, a pair of mandibles, and two pairs of maxillae, and a trunk region with one pair of legs on each segment. The anterior pair of trunk appendages (prehensors) is equipped with poison glands. Juveniles may have fewer appendages than adults or may hatch with adult segmentation; new segments are added during developmental molts. Chilopods are found throughout the globe in tropical as well as temperate climates.

**Class Diplopoda**

There are about 8,000 species belonging to class Diplopoda, which comprises the millipedes and is found worldwide. The head region has a pair of antennae, a pair of mandibles, and two pairs of maxillae that are usually fused into a single mouthpart, the chilognatharium. Millipedes possess a tracheal system for respiration. They are herbivores or scavengers on dead plant material. Many are protected by glands that produce toxic or unpleasant compounds.

**Class Pauropoda**

There are about 500 known species belonging to class Pauropoda. Pauropods are soft-bodied, small (0.5–2.0 mm long), soil-inhabiting arthropods that are distributed worldwide. They are elongated and have 9–11 pairs of legs, but they have no trachea and no heart.

**Class Symphyla**

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Members of class Symphyla are rapid runners that range in length from 1 to 4 in. (2.5–10 cm). The class includes some 160 species. They are mainly scavengers on decayed vegetation, but one species, *Scutigerella immaculata*, is a serious pest of certain crops. Symphyllans have twelve pairs of legs and resemble the centipedes.

**Class Insecta**

Class Insecta is the largest of the arthropod classes, containing hundreds of thousands of species. Except for a few primitive or highly modified forms, insects are characterized by having one or two pairs of wings attached to the thorax. The head region bears a pair of antennae, a pair of mandibles, and two pairs of modified maxillae forming the mouthparts. The abdomen is well set off from the thorax and has no appendages except reduced ones that are modified as reproductive organs. The typical insect head bears compound eyes and one or more simple eyes and is covered by a continuous exoskeletal armor. The thorax is made up of three segments, each bearing a pair of legs. The last two segments usually bear a pair of wings. Insects are predominantly terrestrial and have tracheae for gas exchange. Insects are also characterized by unique excretory organs, known as Malpighian tubules, which are useful in conserving water.

Members of the class are extremely varied. They have adapted to many different kinds of feeding and play a variety of important roles in their ecological communities. Mouthparts may be adapted to chewing either plant or animal food, for sucking plant sap or blood, or for lapping or swabbing moisture such as fruit juices or animal body fluids. Some burrow and feed in soil or plant tissue, some are runners or jumpers that feed at or near the ground level, and others feed on the wing.

Most primitive insects are wingless and have a relatively weak exoskeleton. These are forced to seek humid, protected habitats. Juveniles of primitive insects closely resemble the parents and undergo little change other than growth after hatching. This is called ametaboly. Many of the winged insects undergo paurometabolous development, hatching as nymphs that resemble the parent in many ways but that have small buds instead of wings. With each molt these juveniles change somewhat, and the wings increase in size as the young gradually assume the form of the adult. Some insects have adapted to an aquatic life to a certain extent, and in their juvenile stages they are found in ponds and streams. Some of these are hemimetabolous; the juveniles are naiads, i.e., they resemble the nymphs of paurometabolous insects, but their wings do not grow during the juvenile molts, even though other body changes occur. Instead, the last molt before the adult stage is reached involves full development of the wings, after which the insect takes up a terrestrial existence. The least primitive of the insects are termed holometabolous. In holometabolous, the eggs hatch to release the usually wormlike larvae, which are often equipped with false legs in the abdominal region to aid in locomotion. Wing buds are entirely lacking. Although the larvae grow at each molt, they do not begin to resemble the adult until later. During the larval stage the young insect enters into a quiescent pupal stage. At the end of this stage a major metamorphosis occurs, and the insect emerges with all the adult organs.

Insects often cause great losses in agriculture, attack stored products, parasitize humans and domesticated animals and plants, and serve as important carriers of disease organisms. They are also beneficial, producing honey and silk and pollinating the flowers of the majority of flowering plants.

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