

Arachnida

(Spiders, scorpions, mites, and ticks)

Phylum Arthropoda
Class Chelicerata
Subclass Arachnida
Number of families 648

Thumbnail description

Highly recognizable and populous eight-legged invertebrates with two body parts (a prosoma and an abdomen), pedipalps, book lungs or tracheae, sometimes poisonous fangs, and generally the ability to produce silk; they are terrestrial chelicerates (invertebrates with pincer-shaped mouthparts)

Photo: A smooth-headed scorpion (*Opisthophthalmus*) in defensive posture. (Photo by Ann & Steve Toon Wildlife Photography. Reproduced by permission.)



Evolution and systematics

Fossil records suggest that arachnids were among the first animals to live on land, switching from water- to air-breathing. The oldest known arachnid fossils date from the Silurian Period, more than 417 million years ago. It is during this period of time that scorpions (order Scorpionida) appear to have left the water for life on land. Many paleontology experts presume that scorpions were the first animals to make the transition from water to land. In fact, the histological resemblance between the gills of king crabs and the lungs of scorpions help to support this hypothesis. However, the subphylum Cheliceriformes, as a whole, spent many millions of years in the water before it became terrestrial. More than 60,000 species of arachnids are described, although many species, especially mites, remain undiscovered or discovered-but-not-yet-described. Spiders, mites, and ticks constitute the largest and most diverse orders of arachnids. Among the extant species, scorpions are known to have had a long maritime history that continued well after some of them switched to living on land. The marine-living scorpions, at that time, were very large, some up to 3.3 ft (1 m) in length. The harvestmen (daddy longlegs) are also believed to have had a pre-terrestrial history in the sea.

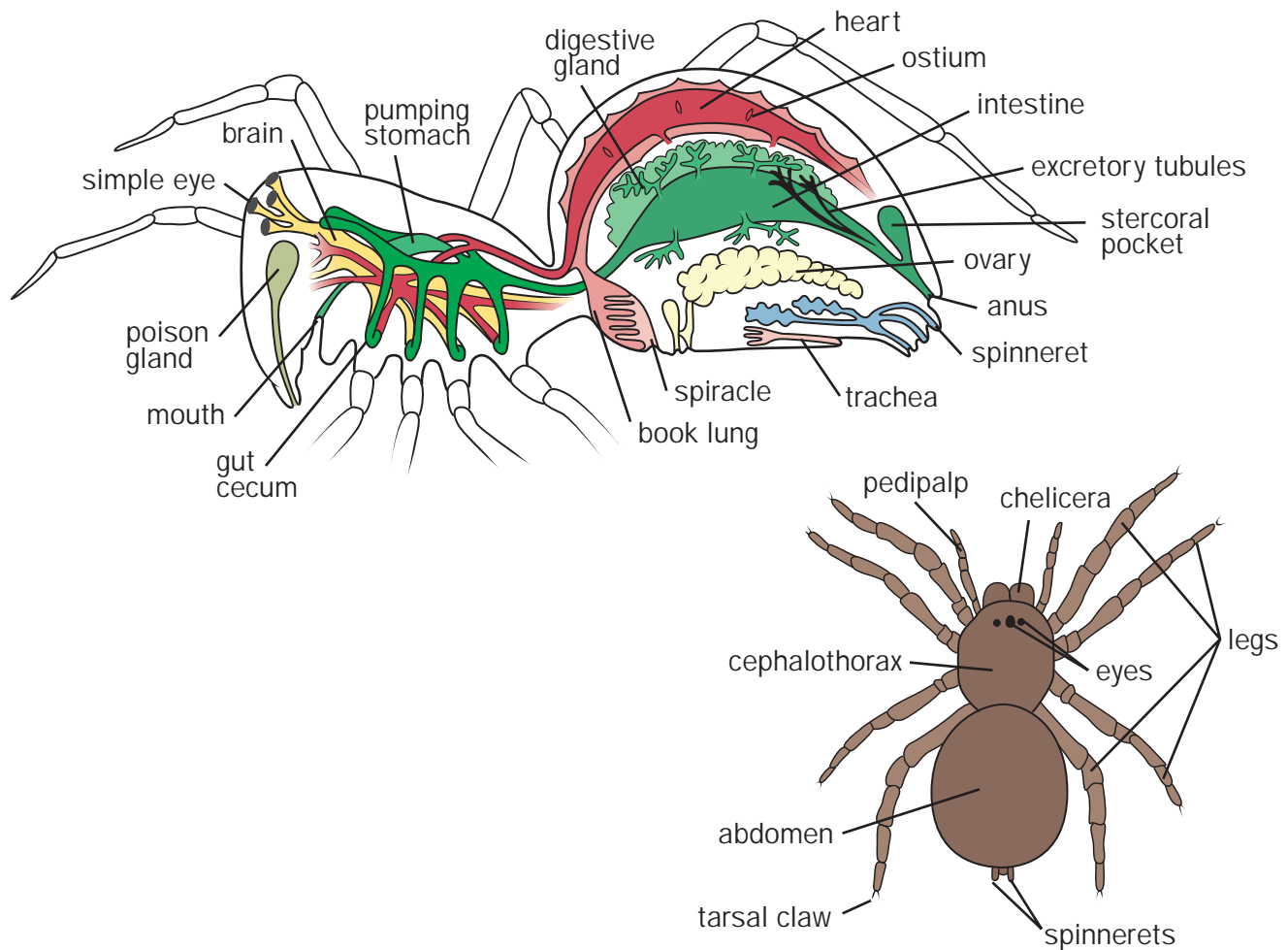
Currently, arachnids constitute the subclass Arachnida, in the phylum Arthropoda. The subclass is divided into 11 distinct orders: Acari (mites, chiggers, and ticks), Amblypygi (tailless whip scorpions), Araneae (spiders), Opiliones (daddy longlegs), Palpigradi (palpigrades), Pseudoscorpiones (false

scorpions), Ricinulei (ricinuleids), Schizomida (micro whip scorpions or schizomids), Scorpionida (scorpions), Solpugida (wind scorpions or solifugids), and Uropygi (whip scorpions and vinegaroons). Many scientists now categorize Arachnida at the class level.

Physical characteristics

There are at least 10 features of arachnids that are often used to describe the group, including:

- carapace may be uniform or in part segmented
- pedicel may be absent or present
- sternum may be uniform or segmented
- opisthosoma may be uniform or segmented
- chelicerae may contain two or three segments (podomeres)
- pedipalpi may be pincer-like or leg-like
- coxae of legs or pedipalpi may or may not contain gnathobases (plate-like anterior expansions)
- first leg may be used as a leg or like an antenna
- legs may be of seven segments (podomeres) or may be sub-segmented anywhere



Arachnid anatomy. (Illustration by Patricia Ferrer)

- coxae may meet and hide the sternum or may be separated

Anatomical features such as two pairs of limbs, the pedipalps and chelicerae, are distinctively present but greatly modified for different uses in various arachnid species.

The 18-segment arachnid body is often protected by sternites below and tergites above, connected by a soft pleural membrane, and is divided into two tagmata: anterior and posterior. The anterior (front) part, called the cephalothorax (or prosoma), contains sense organs, mouthparts, and limbs or appendages in pairs. The cephalothorax is composed of an anterior, unsegmented region called the acron, and six true segments (each bearing a pair of appendages). It accommodates both the head and limbs. A carapace-like shield completely or partially covers the cephalothorax of arachnids. The first pair of limbs (chelicerae) attached in front of the mouth may form pincers or poison fangs, and the second pair (pedipalps) behind the chelicerae may serve as pincers, feelers, or additional legs. The other limb pairs are used for walking. The 12-segment posterior (rear) part of the body, the abdomen (or

opisthosoma), contains the genital opening and other structures. The abdomen may be segmented (as in scorpions) or unsegmented (as in most ticks and spiders). Abdominal appendages are either lacking, or modified into special organs such as the spinnerets of spiders and the pectines of scorpions.

Arachnids breathe by means of tracheae (windpipes), book lungs (modified gills), or both. The mouth of arachnids is not readily noticeable from the external surface. They do not possess jaws (mandibles), but instead have cutting or piercing appendages called chelicerae. The open circulatory system distributes blood from the heart to an enlarged blood space by the use of arteries. The heart is a tubular organ located dorsal to the mid-gut, containing various openings so that blood can be returned to the heart. The central nervous system consists of two cerebral ganglia connected to a pair of sub-esophageal ganglia by means of a circum-esophageal linkage (commisure). Arachnids possess a number of sense organs, many related with the outer body covering (cuticle). The most common of these sense organs is the hair-like setae that are sensitive to various stimuli; they are generally located throughout the surface of the body.

Distribution

Arachnids are found throughout the world from equatorial to polar regions, but reach their most abundant numbers and diversities in very warm to hot, arid and tropical/sub-tropical regions.

Habitat

Arachnids are essentially terrestrial animals that are found in nearly every habitat around the world.

Behavior

Arachnids are terrestrial, except for some mites and a few spiders that can still be found in water. Most arachnids are solitary creatures, other than during mating periods. Even normally sedentary species will roam when in search of a mate. A courtship ritual usually precedes reproduction. A large proportion of their lives are spent in long periods of inactivity, often waiting for prey to stumble upon them. When disturbed by possible danger, they often fall motionless, acting dead, and try to appear nearly invisible to approaching enemies. Regular activities are instinctive by nature, geared primarily toward perpetuating the particular species and activated by external circumstances (such as the general environment and light intensity) and internal adaptations that have been modifying over thousands of years. Some species ambush their prey, while others chase them down. They feed on specialized prey or on many different types of food, depending on species. Arachnids also feed in various ways: as herbivores, scavengers, parasites, cannibals, and carnivores.

Feeding ecology and diet

Arachnids are predaceous, either actively hunting or patiently lying in wait for small animals such as insects. They have various structures that are geared to capturing prey. Some of these features are the segmented, stinging tail of scorpions and the abdominal spinnerets (that allow for the construction of insect traps, or webs) of spiders. Since they do not have the ability to masticate (chew) their food with their mouthparts, they are generally able only to feed on the fluids of their prey. After piercing the prey's body wall with their chelicerae, arachnids will either ingest the fluid contents or digest the tissues externally with enzyme-containing secretions that are ejected from the mid-gut (as with spiders) or the salivary glands (as with ticks and mites). A powerful succorial pharynx draws the fluid up through the pre-oral food canal and delivers it into the mid-gut. Gaseous exchange occurs in a variety of ways. Respiratory gases may enter and leave the body through specialized structures (either lung-books or spiracles) or may diffuse through the cuticle (as in some mites and larval ticks).

Reproductive biology

During mating, a variety of complex behavior patterns are normally observed. Generally, the reproductive organs are



Neon green opiliones seen in Kodagu, Karnataka, India, on a cardamom plantation. Opiliones are also called "daddy longlegs," or "harvestmen," but this also refers to a group of spiders, so this common name is misleading. (Photo by A. Captain/R. Kulkarni/S. Thakur. Reproduced by permission.)

contained in the abdomen and open ventrally on the second abdominal somite. Male sex organs may consist of one diffuse testis or one or two compact testes. The spermatozoa produced are conveyed to a median gonopore through one or two excretory ducts (vasa deferentia). Insemination into the female may come from the male gonopore in a liquid medium (as in spiders) or may be contained in packages called spermatophores (as in ticks and scorpions). An intermittent organ or penis may or may not be present to direct the spermatozoa into the female during mating. Females possess a single or paired ovary, which may be either compact or diffuse and one or two oviducts may lead to the median gonopore. Eggs may be laid underground, in the shelter of a stone, under tree bark, enclosed in a cocoon, or other variations of these methods and structures. Females usually guard eggs or young, which are often born live and as miniatures of the adult with regard to appearance. Eggs may number from one to more than 1,000 in a single brood.

Conservation status

As a group, arachnids are considered abundant all over the world. Some species are diminished in numbers, even considered rare or endangered, because of internal circumstances (such as limitations of habitat) or external circumstances (such as human activities). The 2002 IUCN Red List includes 18 arachnid species: one as Endangered; nine as Vulnerable; one as Lower Risk/Near Threatened; and seven as Data Deficient.

Significance to humans

Most arachnids are harmless and contribute to the give and take of nature by controlling the populations of the insects they prey on or the plants, reptiles, birds, or mammals that serve as their hosts. A few species are serious agricultural pests. The bites of some spiders, such as the black widow spider and the brown recluse spider, and the stings of a few species of scorpions are dangerously poisonous to humans.



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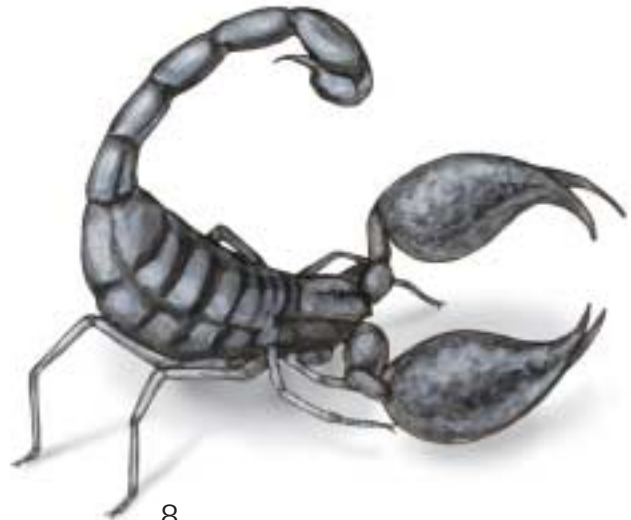
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1. *Phrynos parvulus*; 2. Striped scorpion (*Centruroides vittatus*); 3. Demodicid (*Demodex folliculorum*); 4. Rocky Mountain wood tick (*Dermacentor andersoni*); 5. *Ricinoides afzelii*; 6. Book scorpion (*Chelifer cancroides*); 7. Giant whip scorpion (*Mastigoproctus giganteus*); 8. Emperor scorpion (*Pandinus imperator*). (Illustration by Bruce Worden)