Roundworms, Arthropods

Roundworms (Phylum Nematoda), Arthropods (Phylum Arthropoda)

Ecdysozoans include Nematodes and Arthropods

Ecdysozoans have an outer covering that is shed as the animal grows. Shedding the outer covering is called ecdysis.

Characteristics of Nematodes (Roundworms)

Nematodes have bilateral symmetry with a pseudocoelom (tube within a tube).

Fluid within the pseudocoelom functions to transport nutrients. They do not have a circulatory system.

They are very abundant and occur almost everywhere.

They are not segmented. Do not confuse them with earthworms.

Nematodes are covered by a tough outer layer called a cuticle. The cuticle does not grow; it must be shed as the animal grows. After shedding, a new cuticle is secreted.

These feeding modes occur often among the various roundworm species: carnivores, herbivores, saprotrophs, or parasites.

Examples of Parasitic Nematodes

Ascaris is a parasite that infects the digestive tracts of humans and other mammals.
Trichinella is passed to humans through poorly cooked pork.

Elephantiasis is a human disease caused by filaria worms. It is characterized by gross swelling and malformations due to blockage of lymph vessels by the parasite. A mosquito is a secondary host.

Hookworms are tiny worms that are contracted by walking barefoot on soil that is contaminated with feces from an infected host.

Pinworms are spread in children that put dirty fingers with eggs on them into their mouths.

**Phylum Arthropoda**

Arthropods are bilateral, coelomate protostomes.

They exhibit a variety of specializations and adaptations that allow them to live in many different kinds of habitats.

This phylum exhibits the greatest diversity of the animal phyla with more than 1,000,000 known species. It has been estimated that there may be more than 30 million different species of insects alone! Arthropods may be the most successful of the animals.

**Reasons for Arthropod Success**

**Segmentation**

The ancestral arthropods probably had many segments with a pair of appendages on each segment. The evolutionary trend was for segments to become fused and appendages to become specialized.

The segments of arthropods today are often fused into regions such as the head, thorax, and abdomen. The head and thorax may be fused to form a cephalothorax.
**Exoskeleton**

The external *skeleton* (*exoskeleton*) is composed of protein and *chitin*.

Chitin is hard and serves to protect the animal as well as provide an attachment site for muscles and prevent desiccation. The thickness of the exoskeleton varies. It is very thin and flexible over the joints but thick over other parts of the body.

Because chitin is hard and is not expandable; it requires periodic *molting* (shedding) to allow the animal to grow.

The new skeleton must expand and harden when the old one is shed.

The photograph below shows the exoskeleton of a Tarantula after being shed. Note the openings into the appendages.
Jointed Appendages

Jointed appendages act like a system of levers and are ideal for any activity that requires movement.

Arthropods have evolved a variety of different kinds of specialized appendages for activities such as walking, swimming, reproduction, feeding, sensory reception, and defense.

Well-developed sense organs

Well-developed sense organs are needed for active animals.

Arthropods have both compound and simple eyes.

Insects and crustaceans have compound eyes, each with many separate visual units called ommatidia. Each ommatidium contains a lens and a light-sensitive cell.

Well-developed nervous system

A well-developed nervous system is needed to integrate the sensory information and allow the animal to be active.

The system enables arthropods to exhibit complex behavior.

The nervous system includes a dorsal brain and a double, ventral, solid nerve cord.

Terrestrial forms have an excretory system that conserves water

Arthropods have excretory systems that conserve water.

The Malpighian tubules of insects, arachnids, and some other arthropods move solutes and nitrogenous wastes from the hemolymph (fluid in the circulatory system) into the tubules. The high solute concentration in the malpighian tubules causes water to move in from the hemolymph by osmosis. The material in the malpighian tubules then moves into the
intestine. As the fluid moves through the rectum, most of the solutes are pumped back into the hemolymph. Water then moves back into the hemolymph by osmosis. The result is that relatively dry material is excreted.

**Internal Fertilization**

Males deposit sperm directly into females where fertilization occurs. This type of breeding, called *internal fertilization*, allows animals to breed on dry land. Another advantage is that fewer gametes are needed than if both sexes deposit their gametes in water.

**Coelom and Hemocoel**

The coelom in arthropods is reduced; it consists of a small cavity surrounding the reproductive and excretory organs.

Arthropods have an *open circulatory system*. A fluid called *hemolymph* is pumped by the heart and then enters sinuses where it comes in direct contact with the tissues. These sinuses are referred to as a *hemocoel*. The hemocoel is not part of the coelom.

**Overview of Arthropods (phylum: Arthropoda)**

Three clades of arthropods are listed below.

- **Chelicerates**
  - Arachnids - (Spiders, Scorpions, Harvestmen, Ticks and Mites)
  - Horseshoe Crabs
- **Myriapods**
  - Millipedes
  - Centipedes
- **Pancrustacea**
  - Crustaceans
    - Decapods
    - Isopods
    - Krill
    - Copepods
    - Barnacles
  - Insects

**Chelicerates**

horseshoe crabs, spiders, scorpions, ticks, mites

In cheliceriformes, the first pair of *appendages* in the ancestral arthropod has been modified into pincerlike or fanglike feeding structures called *chelicerae*. In other arthropods, the first appendage is a sensory structure called an antenna.

Chelicerates have 6 pairs of appendages including the chelicerae. In some cheliceriformes, the remaining five pairs of appendages are walking legs. In others, the second pair of appendages is modified for feeding. These animals have four pairs of walking legs.
Chelicerates have a cephalothorax.

**Arachnids (Spiders and relatives)**

Spiders, scorpions, mites, ticks

The second pair of appendages, called pedipalps, is used for feeding. The remaining 4 pairs of appendages are walking legs.

Only simple eyes are found on arachnids.

**Spiders**

Order: Araneae

Spiders are predators. They often capture prey in webs produced by silk glands.

The chelicerae have poison glands to immobilize the prey.

Respiration is book lungs. The respiratory organs are called book lungs because they contain many surfaces that resemble the pages of a book.

Spiders have silk glands that secrete material for producing webs.

The body is fused into a cephalothorax and abdomen.

**Scorpions**

Scorpions are predators. They immobilize their prey by stinging them.
**Harvestmen**

Order Opiliones.

These are often called daddy longlegs because of their long walking legs.

The abdomen and cephalothorax are joined forming a single oval body.

They do not possess silk glands (no webs) or venom.

They have one pair of eyes.

**Ticks and mites**

Ticks and mites are mostly parasites. Ticks feed on the blood of vertebrates.

The cephalothorax and abdomen of ticks and mites are fused into one unit.

**Horseshoe Crabs**

Most of the members of this group have been extinct for millions of years.

Horseshoe crabs are scavengers in the marine environment.

They have a large horseshoe-shaped carapace and pointed tail section (telson).

Respiration is by means of book gills.

The dorsal surface of a horseshoe crab is shown below.

The ventral (underside) surface of a horseshoe crab can be seen below.
Myriapods

The head of myriapods contains a total of four pairs of appendages; one pair are antennae and the other 3 pairs are mouthparts. The remaining body segments contain one or two pairs of appendages on each segment.

Millipedes

Millipedes are cylindrical, slow-moving, nonaggressive scavengers.

Each body segment originated from the fusion of two segments in the ancestral form; thus, millipedes have two pairs of walking legs per segment.

Centipedes

Centipedes are flattened, fast-moving carnivores.

Each body segment has one pair of walking legs.

Pancrustaceans
Crustaceans

Crustaceans include decapods (lobsters and crayfish), copepods and krill, barnacles, and isopods.

Crustaceans have one pair of compound eyes.

The head has 2 pairs of antennae and 3 or more pairs of mouthparts.

The thorax contains walking legs. Crustaceans also have appendages on their abdomen. Lobsters and crayfish have a pair of appendages on their abdomen that is used during copulation.

Biramous appendages on the thorax and abdomen are branched so that two limbs emerge from one attachment to the body.

Decapods

Decapods (lobsters and crayfish) have 5 pairs of legs on the thorax. The first pair is usually modified as claws.

Below: a crab

![Crab](image)

Below: A Crayfish. The body parts have been labeled.

![Crayfish](image)

Decapods have a calcified (impregnated with calcium) exoskeleton.

The head and thorax are fused into a cephalothorax.
Gills are associated with one of the branches of the walking legs.

The carapace has been removed to expose the gills in the photograph below.

The photograph below was taken from above. The carapace has been removed and the gills have been pushed away from the body to show their structure.

The photograph below is a walking leg. Notice that this appendage has two branches. One branch is associated with two gills and the other is the leg.
Copepods and Krill

Copepods and Krill are the most abundant zooplankton (tiny floating animals) in the oceans and are therefore important in food chains. They feed on algae and other organisms feed on them.

Barnacles

Adult barnacles are attached, sessile filter feeders. The larvae are free swimming.

Their modified exoskeleton is a heavy calcareous shell. They may be stalked (goose barnacles) or unstalked (acorn barnacles).

Below: A stalked barnacle

Isopods include terrestrial and marine species

Pill bugs are terrestrial. These animals are known by a variety of different names including sow bugs, potato bugs, roly-polys, and wood lice.

Insects

750,000 species of insects have been described. It has been estimated that there may be 30,000,000 species.

Insects have three pairs of legs and many have one or two pairs of wings.

Insects have both simple and compound eyes.
Gas exchange is accomplished by a system of tubes that extend throughout the animal called **tracheae**.

They exhibit complex behavior. For example, bees, ants, and termites exhibit social behaviors such as cooperative feeding, raising of young, and housekeeping.

**Metamorphosis**

The change in body form as an insect grows to adult is **metamorphosis**. In some species, the **larvae** look like the adult; the animal simply gets larger as it matures. This type of change is **incomplete metamorphosis**. Grasshoppers undergo incomplete metamorphosis.

Species that undergo a complete reorganization of the body tissues exhibit **complete metamorphosis**. Worm-like larvae form a cocoon called a **pupa** and then become transformed into the adult form. Flies and butterflies undergo complete metamorphosis.

Complete metamorphosis allows the animal to take advantage of two different ecological settings (niches). For example, caterpillars are specialized for feeding on plant leaves. The butterfly of many species is specialized for finding mates and reproduction.

The photograph below shows three stages in the complete metamorphosis of a fly. The larva is on the left, a pupa is in the center and adult on the right.

![Photo of metamorphosis stages](https://bio.libretexts.org/Under_Construction/BioStuff/BIO_102/Reading_and_Lecture_Notes/Roundworms%2C_Arthropods)

**Example - Grasshopper**

Grasshoppers have tough, leathery forewings and broad, thin hindwings.

**Digestive System**

The mouth contains grinding mouthparts. Food in the mouth is mixed with saliva, which contains enzymes that begin the process of digestion.

The **crop** functions in storage. Upon leaving the crop, food enters the **gizzard** where it is ground into smaller particles.

Most chemical digestion occurs in the **stomach**. Absorption of nutrients occurs in the stomach and pouches that are attached to the stomach called **gastric caeca**. Absorbed nutrients move into the hemocoel.

The **intestine** functions mostly to absorb water.

**Excretion**

Malpighian tubules remove **nitrogenous wastes** and empty them into the intestine.
Respiration

Insects have a network of tubules called tracheae that bring oxygen directly to the tissues and allow carbon dioxide to escape. The openings to the outside, called spiracles, are located on the side of the abdomen. Air sacs attached to the tubules pump air through the system.

Reproduction

Grasshoppers have internal fertilization. Sperm are delivered directly to the female by the male's penis. This ability enables insects to breed in terrestrial environments.

The female's ovipositor deposits eggs in the ground.

Impact of Insects on Humans

Beneficial Insects

Pollination

Important in many food chains

Some species are important detritus feeders, breaking down dead organic material.

Useful products

- Honey, beeswax (bees)
- Silk (silkworms)

Some species destroy other species that are harmful to humans.

Harmful Insects

Some species carry diseases.

- Tsetse flies carry Trypanosoma.
- Mosquitoes carry Plasmodium (malaria).

Some species are parasites (mosquitoes, lice, fleas).

Some species have painful bites and stings (mosquitoes, fire ants).

Crop destruction by insect activities has a major economic impact.

Termites damage buildings.
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