Shape of Life
The Story of the Animal Kingdom

Terrestrial Arthropods Fact Sheet

Bold and Adaptable Explorers

Arthropods were the first animals to venture from the sea onto land and spread over the Earth. Fossil tracks suggest that an arthropod left the water to walk on land around 400 million years ago. Today, there are over seven million terrestrial arthropods. The vast majority are insects. The key to their amazing diversity and success on land and in the air is their adaptable body plan.

Two major adaptations allowed arthropods to conquer both land and air:

- To move from the sea to land, arthropods needed a different way to take in **oxygen**. Terrestrial arthropods evolved special organs for absorbing oxygen from air instead of water.
- Insects also evolved **wings**. They began to fly soon after their ancestors first came ashore. Learning to fly may be the single most important adaptation. It allowed insects to eventually dominate every habitable ecosystem on Earth.

Shared Body Structures

Arthropods have many different shapes and distinct body parts. But land-based arthropods have **five structures in common**:

1. A Segmented Body

- All arthropod bodies are divided into **segments**.
- In many species, the segments are grouped into three units: the **head**, **thorax**, and **abdomen**.
- Some species like pill bugs have a **cephalothorax**, which is a fused head and thorax.
- Usually, each segment has a pair of appendages.

2. Jointed Appendages

- Segmentation allowed these organisms to evolve specialized **appendages**. Appendages are limbs or other projecting parts.
- In primitive arthropods, each segment had a similar appendage. Through evolution, appendages adapted to become the legs, antennae, claws, and mouthparts. These all perform different functions.

A spider saves a meal by wrapping it in its silk, which has been found to be five times stronger than steel. Spiders are helpful arthropods in gardens for pest control.

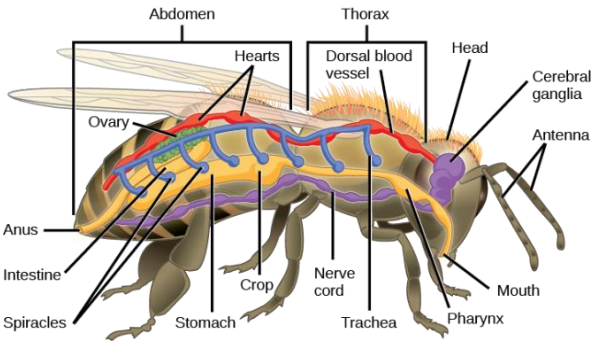
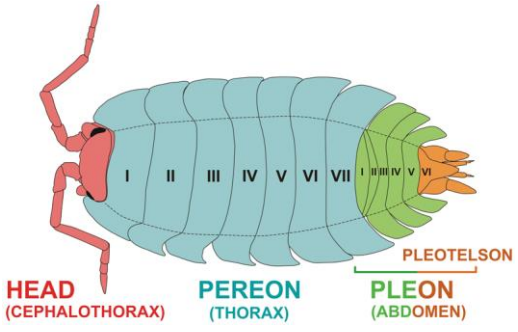


Diagram of a bee showing its three main body segments: head, thorax, and abdomen
CNX OpenStax, Wikimedia Commons



The pill bug (woodlouse) body plan includes a cephalothorax (fused head and thorax).
Darekk2, Wikimedia Commons

- Appendages are segmented, which makes them flexible. They are controlled by tendons and powerful muscles.
- Jointed legs allow flexibility and range of motion. They can work as shock absorbers. The name arthropod means "jointed foot" in Greek.

3. An Exoskeleton

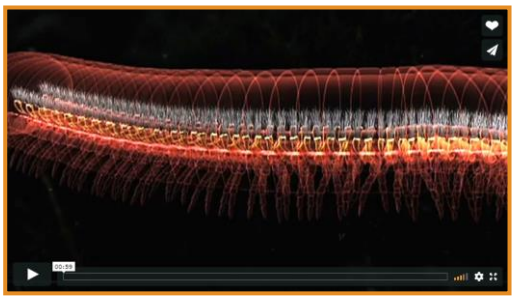
- A rigid structure, called an **exoskeleton**, covers the body. This hard shell is made of a nitrogen-rich sugar called **chitin**. In contrast, **vertebrates** like birds, mammals, and reptiles have an internal skeleton.
- The exoskeleton supports the body and provides protection like armor. It also prevents water loss. Body parts and muscles attach to the inside of the exoskeleton.
- Wings develop as an outgrowth of the exoskeleton. They only become functional in the adult.
- Because their exoskeletons are rigid, arthropods must shed them in order to grow. This process is called **molting**. The arthropod sheds its exoskeleton and grows a new one.

4. Bilateral Symmetry

- **Bilateral symmetry** describes a type of body plan. It means the left side of the body is basically a mirror image of the right side of the body.
- The number of appendages on the left side is equal to the number of appendages on the right side. Many other animals, including worms, snails and humans, have bilateral symmetry.

5. Respiration Adapted to Land

- On land, arthropods evolved different ways to breathe air. Some organisms, like scorpions, have internal book gills, or **book lungs**.
- Insects developed a **tracheal system.** They pull air into their bodies through tiny pores on their undersides. They send it through their bodies in an open system without fluid. This allows them to deliver oxygen directly into their muscles. This system proved very efficient at delivering oxygen to the fast-moving flight muscles.
- Millipedes take in air through holes (**spiracles**) and distribute it throughout their bodies through breathing tubes.



Jointed appendages like legs and antennae—not to mention their armor-like exoskeletons—helped arthropods conquer the world's ecosystems.

A monarch butterfly shows off its beautiful wings and bilateral symmetry. These pollinators are threatened by habitat loss, pesticides, and climate change. Learn more, including ways to help: nwf.org/Our-Work/Wildlife-Conservation/Monarch-Butterfly.

Scene from "Arthropod Animation: Scorpion Book Gills" video from Shape of Life: shapeoflife.org/video/arthropod-animation-scorpion-book-gills

Scene from "Millipede Breathing Tubes" video from Shape of Life: shapeoflife.org/video/arthropod-animation-millipede-breathing-tubes

Life Cycle

All arthropods begin life as fertilized eggs. Most species then hatch as juvenile **larvae**, unable to reproduce. Insects such as butterflies and mosquitoes go through **complete metamorphosis**. Their bodies transform in four life stages: egg, larva, pupa, and adult. The larvae often live in a different habitat than the adult. This allows them to take advantage of a different food source. Caterpillars, which are larval butterflies, feed on leaves. Larval mosquitos live in water and feed on algae.

Some species, such as grasshoppers, go through **partial metamorphosis**. They emerge from eggs as smaller versions of their adult forms. They go through several **molts** to grow into adults.

Scene from "Arthropods: Dragonfly Metamorphosis" video from Shape of Life: shapeoflife.org/video/arthropods-dragonfly-metamorphosis

Classification

Animals in the phylum **Arthropoda** have a huge variety of body shapes and ways of living. Some distinct groups of terrestrial arthropods are:

- **Chelicerates**, which include spiders and scorpions
- **Crustaceans**, which include marine and land-based crabs and woodlice (pill bugs)
- **Insects** (class Insecta) are found on every continent, including Antarctica! They include bees, butterflies, beetles, crickets, dragonflies, and mosquitoes. **Flying** insects alone make up more than 75% of all known animal species! Insects are critical to humans as pollinators.
- **Myriapods**, which include millipedes and centipedes.

Newly-hatched spiderlings (subphylum Chelicerata, class Arachnida)

Learn More with Shape of Life Videos

- "Terrestrial Arthropods: The Conquerors": shapeoflife.org/video/terrestrial-arthropods-conquerors
- Arthropod Locomotion: Engineering": shapeoflife.org/video/arthropod-locomotion-engineering
- "Arthropod Animation: Millipede Breathing Tubes": shapeoflife.org/video/arthropod-animation-millipede-breathing-tubes
- "Arthropod Animation: Scorpion Book Gills": shapeoflife.org/video/arthropod-animation-scorpion-book-gills
- "Arthropod Animation: Swiss Army Knife": shapeoflife.org/video/arthropod-animation- swiss-army-knife
- "Arthropods: Dragonfly Metamorphosis": shapeoflife.org/video/arthropods-dragonfly-metamorphosis
- Arthropods: Dragonfly Larva Hunts Newt": shapeoflife.org/video/arthropods-dragonfly-larva-hunts-newt

A myriapod shown in the "Arthropod Locomotion: Engineering" video from Shape of Life: shapeoflife.org/video/arthropod-locomotion-engineering

Scene from "Arthropod Animation: Swiss Army Knife": shapeoflife.org/video/arthropod-animation- swiss-army-knife