

EXPLORING OUR FLUID EARTH *Teaching Science as Inquiry (TSI)*

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What is an Invertebrate?

NGSS Performance Expectations: MS-LS1-3 Use argument supported by evidence for how the body is a system of interacting subsystems composed of groups of cells.

MS-LS4-1 Analyze and interpret data for patterns in the fossil record that document the existence, diversity, extinction, and change of life forms throughout the history of life on Earth under the assumption that natural laws operate today as in the past.

MS-LS4-2 Apply scientific ideas to construct an explanation for the anatomical similarities and differences among modern organisms and between modern and fossil organisms to infer evolutionary relationships.

HS-LS4-1 Communicate scientific information that common ancestry and biological evolution are supported by multiple lines of empirical evidence.

The content and activities in this topic will work towards building an understanding of invertebrate animals as a crucial component of life within the world ocean.

Introduction to Invertebrates

Invertebrates are animals without backbones. Fig. 3.2 shows some examples of invertebrate animals. Ask most people to give you an example of an animal, and they will answer with familiar examples like birds, dogs, cats, monkeys, whales, fishes, and frogs. These are all animals we call vertebrates. They have dorsal nerve cords that are encased in hard protective backbones or vertebrae (singular: vertebra). Most of the animals featured on television and in zoos are vertebrates. Perhaps we think of vertebrates first when talking about animals because to humans, these organisms are familiar and comfortable. However, the vast majority of animal life on our planet is made up of animals without backbones: the invertebrates. Of the approximately 35 phyla in the kingdom Animalia, only one phylum—the phylum Chordata—contains animals that have backbones.



Fig. 3.2. (A) Red encrusting sponge (*Monanchora arbuscula*; phylum Porifera)

Image courtesy of Nick Hobgood, [Wikimedia Commons](#)



Fig. 3.2. (B) Lion's mane jellyfish (*Cyanea capillata*; phylum Cnidaria)

Image courtesy of Kip Evans, [Wikimedia Commons](#)



Fig. 3.2. (C) Deep-water shrimp (*Heterocarpus ensifer*; phylum Arthropoda)

Image courtesy of National Oceanic and Atmospheric Administration ([NOAA](http://noaa.gov))



Fig. 3.2. (D) Marine king ragworm (*Alitta virens*; phylum Annelida)

Image courtesy of Alexander Semenov, [Flickr](https://www.flickr.com/photos/alexandersemenov/)

Scientists continue to debate the total number of living species on Earth. Scientists have formally described approximately 1.6 million species. New species continue to be discovered, especially among groups that have small body sizes or live in remote areas such as the deep sea, polar ice, or cloud forests. Estimates of the total number of species range from two million to 20 million. The International Union for the Conservation of Nature (IUCN) offers a low-end estimate of approximately 1.37 million surviving species of animals. Among these 1.37 million animal species, only about 66,800 species are vertebrates. The remaining 1.3 million species are invertebrates.

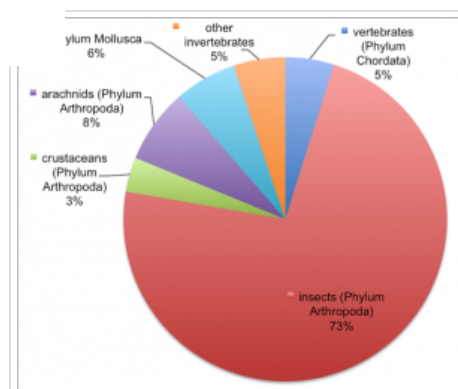


Fig. 3.3. Percent contribution of species from the major groups within the kingdom Animalia.

Source: International Union for the Conservation of Nature (IUCN) 2015
Image by David Lin

In terms of species diversity, the invertebrates far outpace the vertebrates. Only five percent of all known living animal species are vertebrates or animals with backbones (Fig. 3.3). The vast majority of animal species (95 percent) are invertebrates. Among all animal species, one particular group easily claims the highest number of species: the insects. Insects—a group within the phylum Arthropoda—have evolved into several millions of species, particularly beetle insects (order Coleoptera). Approximately three out of every four animal species is an insect, and one in three animal species is a beetle!

Scientists think that 1.37 million animal species offers a low-end estimate of the total number of animal species on Earth. What might happen to our pie graph (Fig. 3.3) as more species are discovered and described? In general, it is reasonable to think that most of the large mammals and other vertebrates have been found and described, with only a very small proportion (such as deep sea fishes) remaining as yet unknown. Many invertebrates are small and dwell in hard-to-reach places. For example, the group of worms called nematodes currently consists of about 200,000 described species. However, scientists believe that there may be as many as

1,000,000 species in existence. There are probably thousands upon thousands of invertebrates as yet undescribed. The percentage of animals without backbones is likely only to increase as new species are discovered.

WEIRD SCIENCE

▶ Weird Science: Cool Invertebrate Facts

Major Invertebrate Phyla

Biologists currently recognize 35 different phyla within the kingdom Animalia. Many of these phyla are relatively obscure and rare. For example, the phylum Cycliophora contains only one genus of microscopic animals found exclusively on the mouthparts of lobsters.

This unit will discuss the defining characteristics of the following nine major animal phyla:

- Porifera
- Cnidaria
- “Worms” in the phyla Platyhelminthes, Nematoda, and Annelida
- Mollusca
- Arthropoda
- Echinodermata
- Chordata

QUESTION SET

▶ Question Set: What is an Invertebrate?

FURTHER INVESTIGATIONS

▶ Further Investigations: What is an Invertebrate?

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