SECTION 2

# The Animal Kingdom

**Key Concept** Animals are a diverse group of organisms that have adaptations to live in water and on land.

### What You Will Learn

- The animal kingdom is made up of many different kinds of animals.
- Animals can be divided into two main groups: invertebrates and vertebrates.
- Each group of animals has unique characteristics.

### Why It Matters

Studying the characteristics of an animal will help you understand how the animal survives in its environment.

### Vocabulary

- invertebrate
- exoskeleton
- vertebrate
- endoskeleton

**READING STRATEGY**

**Graphic Organizer** In your **Science Journal,** make a Pyramid Chart that ranks the invertebrates discussed in this section by levels of complexity.

Both eagles and butterflies have wings. Are eagles and butter flies closely related because they both have wings? The answer is no. Butterflies are insects, and eagles are birds. Insects, birds, and other animals show great diversity in body structure and function, as well as in how and where they live.

## Animal Diversity

Scientists have named more than 1 million species of animals. Many species that exist have not yet been discovered and named. Some scientists estimate that more than 3 million species of animals live on Earth. Some of these animals are becoming extinct before they have been discovered or described.

Animals that have been discovered and described have been placed into groups. Placing animals into groups makes it easier to study all of the different kinds of animals. The pie graph in **Figure 1** shows the proportions of the main groups of animals in the animal kingdom.

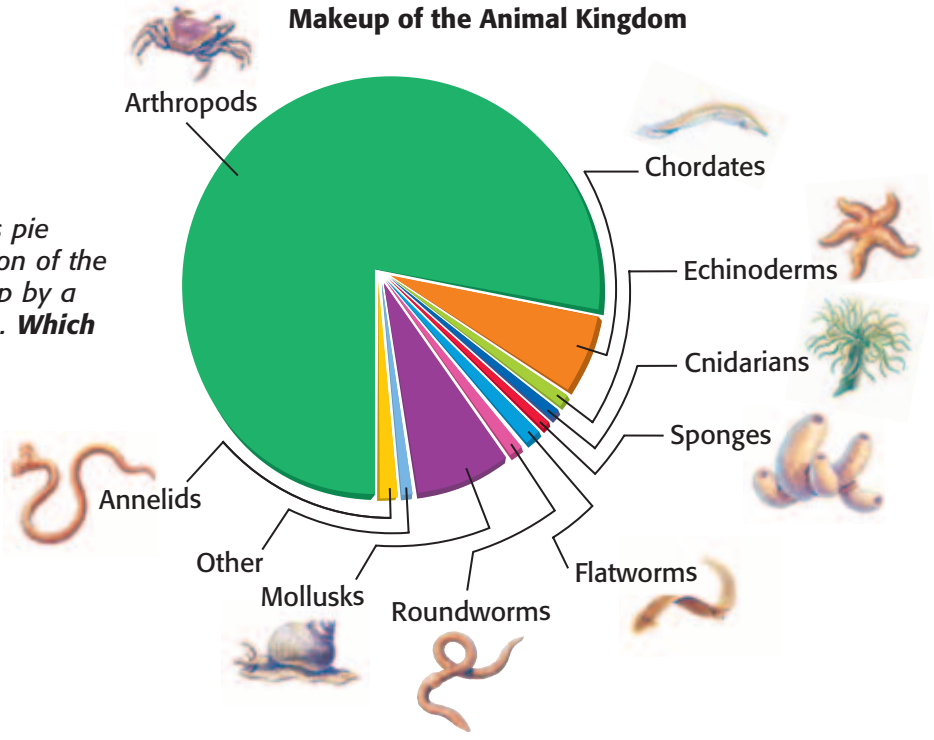



**Figure 1** *Each slice in this pie graph shows what proportion of the animal kingdom is made up by a particular group of animals.* ***Which group is the largest?***

**7.5.a** Students know plants and animals have levels of organization for structure and function, including cells, tissues, organs, organ systems, and the whole organism.

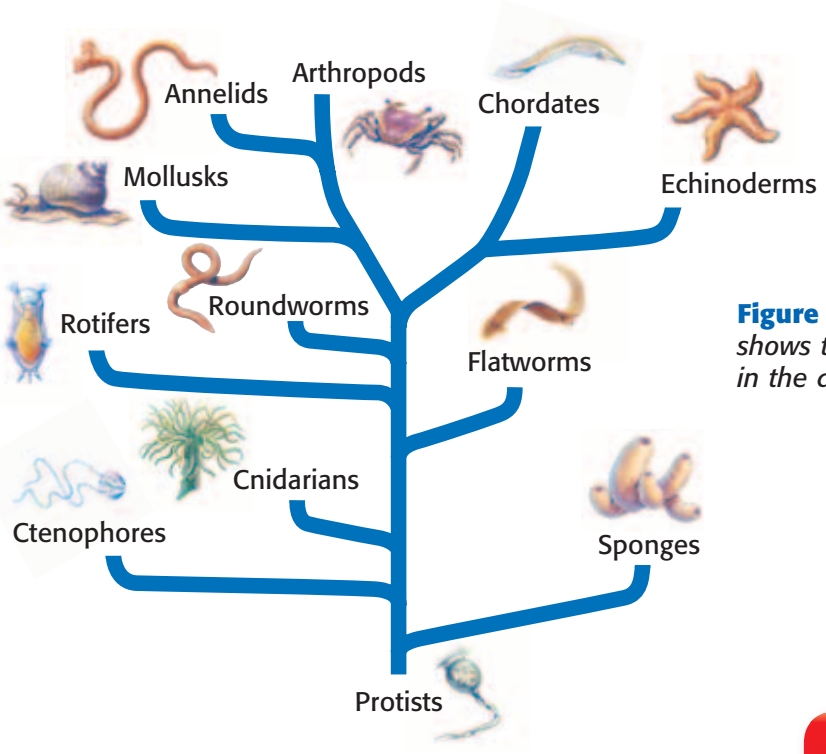



**Figure 2** *This diagram shows the major groups in the animal kingdom.*

## Classification

Scientists organize animals into groups based on the animals' characteristics and evolutionary relationships. In the past, scientists grouped animals based on only structural characteristics, such as symmetry. Today, scientists also use DNA to place animals into groups. **Figure 2** shows groups of animals and how they are related to each other. All animals, except for most of the members of chordates, are known as *invertebrates*.

## Invertebrate Characteristics

Most of the animals on Earth are invertebrates. An **invertebrate** is an animal that does not have a backbone. In fact, invertebrates do not have any bones. Insects, snails, jellyfish, and worms are all examples of invertebrates. Invertebrates can be found living in every environment on Earth. Sponges are some of the simplest invertebrates.

### Sponges

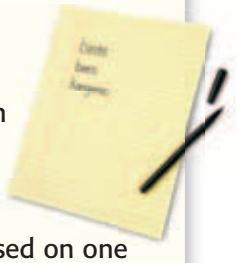
Most sponges live in the ocean. Sponges have an asymmetrical body plan. A sponge is a mass of specialized cells that is held together by a jelly-like material. Tiny, glassy structures in the sponge also provide support. The body of a sponge has many tubes and thousands of small holes or *pores*. A sponge sweeps water through the pores into the tubes. In the tubes, specialized cells filter and digest food particles from the water. Sponges reproduce asexually by fragmentation and sexually.

***Standards Check*** **Describe the body of a sponge.** 7.5.a

## Quick Lab

7.5.a

### Grouping Organisms by Characteristics



1. On a **sheet of paper,** write a list of six organisms from this chapter.
2. Divide the organisms into two groups based on one characteristic. Record the animals in each group.
3. Divide each group into two new groups based on a different characteristic. Keep a record of the animals in each group.
4. Repeat step 3 until there is only one animal in a group.
5. Exchange your list with an other student, and try to fig ure out the characteristics the student used to divide his or her list of organisms.

15 min

**invertebrate** (in VUHR tuh brit) an animal that does not have a backbone

**Figure 3** *This jellyfish has a medusa body form. It floats in ocean currents and traps prey with its tentacles.*

## Cnidarians

Cnidarians are also invertebrates, but they are more complex than sponges. Most cnidarians (ni DER ee uhnz) live in the ocean. The three major classes of cnidarians are hydrozoans (HIE droh ZOH uhnz), jellyfish, and sea anemones and corals.

Cnidarians have one of two radially symmetrical body plans—the *medusa* or the *polyp* form. The medusa is a cup or bell-shaped body that has tentacles extending from it. The jellyfish **Figure 3** shows, has the medusa body form. Sea anemones and corals have medusa body forms when they are young, or *larvae*. As adults, sea anemones and corals have polyp body forms. Polyps attach to hard surfaces at the base of the cup. The tentacles of the animal then extend into the water. Specialized stinging cells, called *cnidocytes* (NEE doh siets), are located on the tentacles. Cnidocytes are used to stun and capture prey. Many cnidarians reproduce by sexual reproduction. Some cnidarians can also reproduce by budding or fragmentation.

**Standards Check** **Describe two cnidarian body plans.** 7.5.a

## Flatworms

Flatworms are the simplest worms. Many flatworms live in water, while some live in damp soils. Other flatworms are parasites. A parasite is an organism that invades and feeds on the body of another organism. For example, tapeworms are parasites that live in the intestines of humans.

Flatworms have more-complex bodies than sponges or cnidarians do. Flatworms have flat bodies that are bilaterally symmetrical. The flatworm, as **Figure 4** shows, has a clearly defined head with eyespots, which are sensitive to light. Flatworms reproduce both sexually and by fragmentation.

## Roundworms

**exoskeleton** (EKS oh SKEL uh tuhn) a hard, external, supporting structure
**Wordwise** The prefix *exo-* means "outside" or "external." Another example is *exotic.*

Unlike flatworms, roundworms have a coelom and are cylindrical, like spaghetti. Roundworms also have bilateral symmetry. Most roundworms are little more than 2 cm long. They live in freshwater habitats, in damp soils, and as parasites in the tissues and body fluids of other animals. Some roundworms eat tiny organisms. Other roundworms break down dead organisms and make soils more fertile.

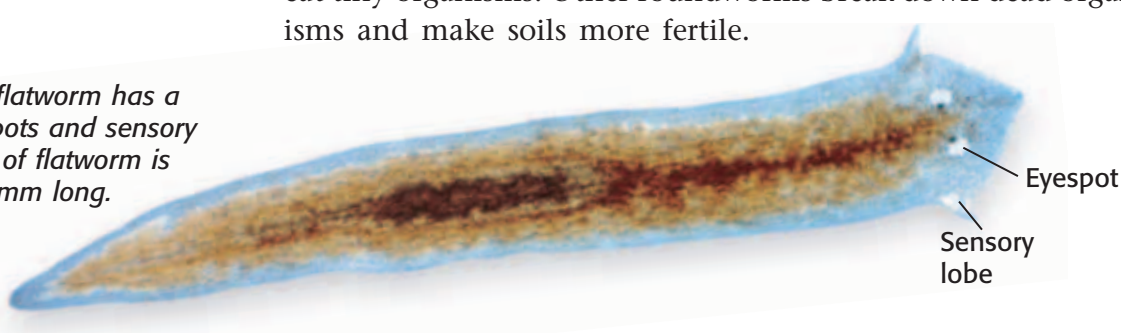



**Figure 4** *This flatworm has a head with eyespots and sensory lobes. This kind of flatworm is often about 15 mm long.*

## Mollusks

Snails, slugs, clams, oysters, squids, and octopuses are mollusks. Although most mollusks live in the ocean, some live in fresh water. Others live on land. Mollusks have a specialized tissue called a *mantle*. The mantle secretes the shell of snails, clams, and oysters. Mollusks also have a muscular foot. Snails use the foot to move. In squids, such as the one in **Figure 5,** and in octopuses, the foot has evolved into tentacles. Squids and octopuses use their tentacles to capture prey, such as fish. Mollusks that do not have tentacles feed differently. Clams and oysters filter food from the water. Snails and slugs feed on plants and break down dead organisms. Mollusks reproduce sexually.

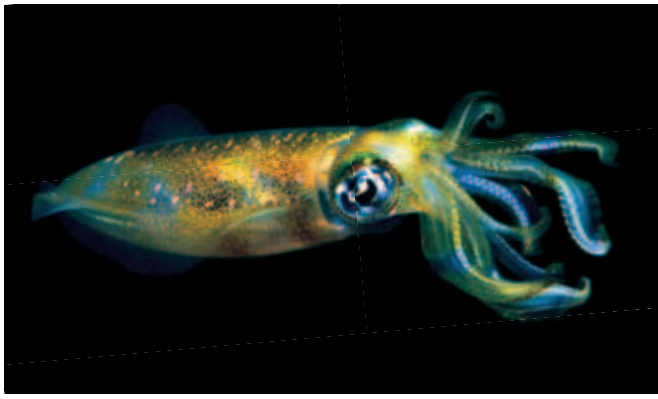


**Figure 5** *The squid is a mollusk that moves by forcing water out of its mantle.*

## Annelids

Annelids live in the ocean and on land. Annelids have round, bilaterally symmetrical bodies. Because annelids are made up of repeating compartments, or segments, annelids are also called *segmented worms*. Leeches are annelids that suck blood. Earthworms, such as the worm in **Figure 6,** break down dead organisms as they burrow through soil. Marine annelids eat mollusks and small animals. Each annelid has both male and female sex organs. But individuals cannot fertilize themselves. Individuals fertilize each other to reproduce sexually.

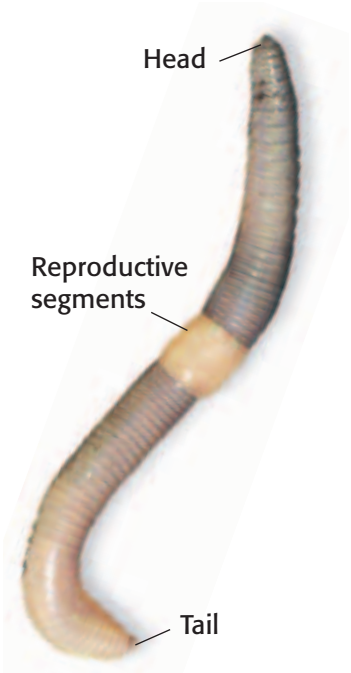



**Figure 6** *Except for the head, tail, and reproductive segments, all of the segments of this common garden earthworm are identical.*

## Arthropods

Arthropods are the most diverse group in the animal kingdom. Arthropods have bilaterally symmetry and a strong, external armor called an **exoskeleton.** The exoskeleton provides defense against predators. The exoskeleton also prevents the animal from drying out in the air and in the sun. Insects, such as the bumblebee in **Figure 7,** are a familiar group of arthropods that live on land. Insects' bodies are clearly divided into a head, thorax, and abdomen. Millipedes, centipedes, and arachnids, such as spiders, and scorpions are also arthropods. Arthropods that live in the water include crab and shrimp. Most arthropods are either males or females and reproduce sexually.

**Figure 7** *The bumblebee has two antennae, two wings, six legs, a head, a thorax, and an abdomen.*

**Figure 8** *Sea urchins are common in kelp forests along the coast of California.*

## Echinoderms

Echinoderms (ee KIE noh DUHRMZ) are invertebrates that live in the ocean and include sea stars, sea urchins, and sand dollars. The name *echinoderm* means "spiny skinned." Echinoderms, such as the sea urchins in **Figure 8,** have an exoskeleton covered in bumps and spines. Echinoderms have bilateral symmetry as larvae but have radial symmetry as adults. They also have a unique system of canals filled with water called the *water vascular system* (WAWT uhr VAS kuh luhr SIS tuhm). The water vascular system uses water pumps to help the animals move, eat, breathe, and sense the environment. Most echinoderms feed by scavenging and filtering food out of the water. However, many sea stars prey on mollusks, such as clams.

Echinoderms usually reproduce sexually. For fertilization to take place, males release sperm into the water and females release eggs into the water. Larvae are formed when the sperm fertilizes the eggs. Some sea stars can regenerate a whole individual from an arm that is cut off. This is a form of asexual reproduction.

# Vertebrate Characteristics

**vertebrate** (VUHR tuh brit) an animal that has a backbone

**endoskeleton** (EN doh SKEL uh tuhn) an internal skeleton made of bone and cartilage

Vertebrates belong to the phylum Chordata. Members of this phylum are called *chordates* (KAWR DAYTS). Lancelets (LANS lits), such as the one shown in **Figure 9,** and tunicates (TOO ni kits) are also chordates. All chordates share some characteristics, such as a *notochord*, during their life cycle. The notochord is a stiff but flexible rod that supports the body of the animal.

**Figure 9** *Lancelets are one of the few marine organisms grouped as chordates. A lancelet has a notochord but does not have a backbone.*

As a vertebrate develops, the notochord is replaced by a backbone. **Vertebrates** are animals that have backbones. The backbone is a strong but flexible column of individual bony units called *vertebrae* (VUHR tuh BRAY). The backbone is a part of the endoskeleton of a vertebrate. An **endoskeleton** is an internal skeleton that supports the body of the animal and provides a place for muscles to attach. Muscles that are attached to the endoskeleton allow the animal to move.

Less than 5% of the known animal species are vertebrates. Vertebrates are divided into five main groups: fishes, amphibians, reptiles, birds, and mammals. Vertebrates can live in water and on land. Some vertebrates feed on only plants or on only animals. Some feed on both plants and animals. Vertebrates are either male or female and reproduce mainly by sexual reproduction.

**Standards Check** **How do lancelets differ from vertebrates?** 7.5.a

## Fish

More than half of the species of vertebrates are fish. The oldest recognizable vertebrates that appeared nearly 500 million years ago were small, odd-looking fish without jaws. Today, there are two small groups of jawless fishes. All other fishes can be divided into two main groups: the *cartilaginous fish* and the *bony fish*. Cartilaginous fish have a skeleton made of a flexible tissue called *cartilage*. This group includes sharks and stingrays. All other fish have a bony skeleton. Bony fish, such as the Garibaldi in **Figure 10,** are found in marine and freshwater environments around the world.

**Figure 10** *This Garibaldi, is a bony fish that is commonly found in the kelp forests along the coast of California.*

## Amphibians

Most modern amphibians live near fresh water because their eggs and larvae need water to survive. Salamanders, frogs, toads, and caecilians are amphibians. Adult frogs, such as the frog shown in **Figure 11,** and toads do not have tails. Frogs and toads have long hind legs used for hopping and swimming. Adult salamanders have tails, and most have legs equal in size to the tail. Like frogs, some salamanders live completely in the water. However, others spend their lives on land and return to water only to reproduce. Caecilians are tropical amphibians that live under logs and in burrows. All amphibians have thin skins that must be moist. Most amphibians have an aquatic larval stage in their life cycle. In the larval stage, a frog is called a tadpole.

**Figure 11** *The Pacific Tree frog can be found in western North America, including California.* ***By studying this photo, can you tell which part of its life cycle this frog has reached?***

## Reptiles

Reptiles live nearly anywhere on land because they do not need water to lay their eggs. Reptile eggs are protected from drying out by membranes and a shell. Some reptiles, such as turtles, alligators, and snakes can also live in water. Some reptiles feed on plants. Other reptiles feed on insects and other arthropods. Some reptiles, such as the snake in **Figure 12,** eat other vertebrates. Reptiles mainly reproduce sexually.

**Figure 12** *Both the caiman and the snake are reptiles. The caiman and the snake share many characteristics, such as tails and scaly skins.*

## Birds

**Figure 13** *The California brown pelican can live on land and on water. Pelicans feed on fish.*

Some birds live on land. Others live in the water. Birds such as the pelican in **Figure 13** live on land and on the water. Birds share many characteristics with reptiles, such as similar structures in their feet. But birds also have unique characteristics. For example, birds are the only living animals that have feathers. Feathers are important for maintaining body temperature. Feathers also help shape the body and the wings for flying. Some birds, such as the penguin, no longer use their wings to fly. The penguin uses its wings to swim. Birds such as the ostrich and emu do not fly but have unique characteristics that help them run. All birds reproduce by sexual reproduction.

**Standards Check** **List two reasons that feathers are important?** 7.5.a

## Mammals

All of the approximately 5,000 species of mammals share certain characteristics. For example, all mammals have hair, and all female mammals can produce milk for their young. Some members of the three main groups of mammals are shown in **Figure 14.** The echidna is a monotreme. Monotremes lay eggs that have shells. Kangaroos and opossums are marsupials or "pouched mammals." Marsupials give birth to embryos. The embryos continue to develop in their mother's pouch. The sea otter is a placental mammal, which means that is has a placenta in its uterus. The *placenta* is an organ through which nutrients and wastes are exchanged between the mother and developing offspring. All mammals reproduce by sexual reproduction.

**Figure 14** **Examples of Three Kinds of Mammals**

**Echidna (monotreme)**

**Kangaroo (marsupial)**

**Sea Otter (placental mammal)**