Vertebrates

A Science A–Z Life Series

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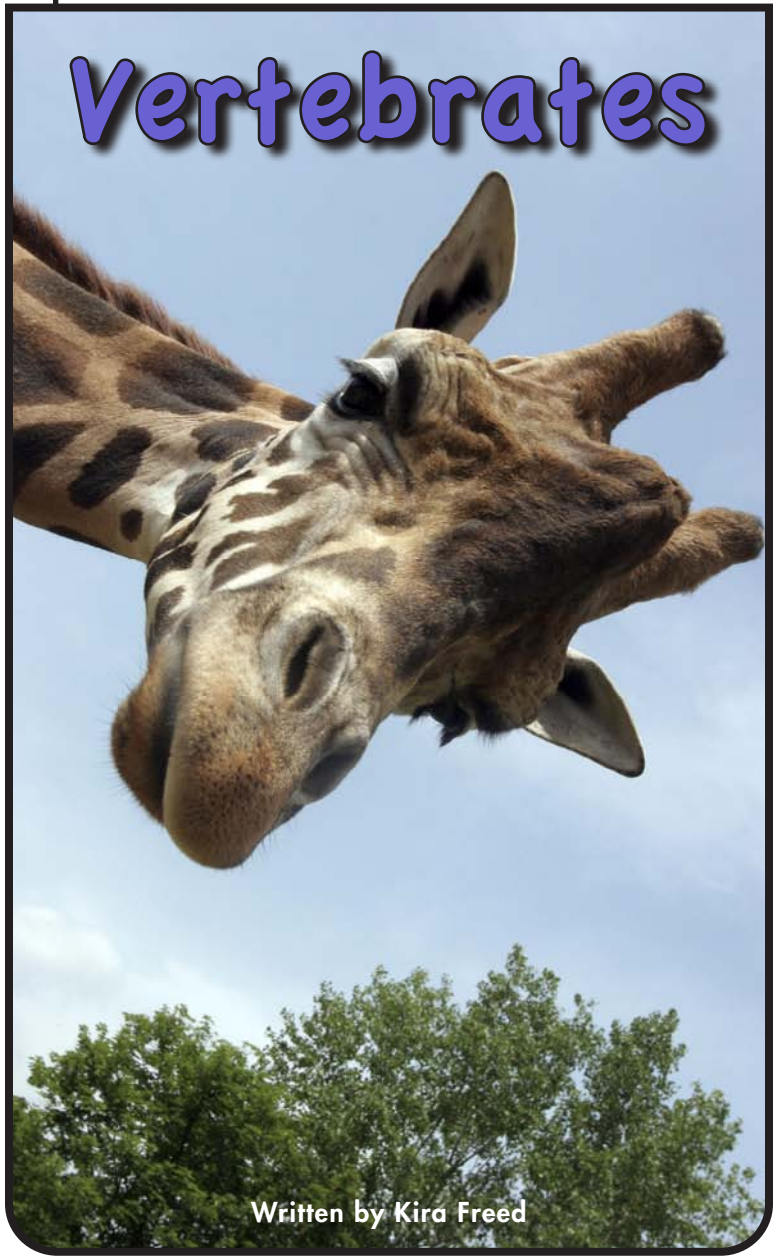
Vertebrates



Written by Kira Freed

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KEY ELEMENTS USED IN THIS BOOK
The Big Idea: We can sort animals into two large groups—vertebrates and invertebrates. All vertebrates, including humans, have skeletons that allow us to perform important activities. By learning about the importance of our own skeleton, we are more likely to take better care of our body by eating well and by being careful to avoid bone breaks. Also, when we learn about other vertebrates, we may increase our concern for their protection and well-being.
Key words: amphibian, babies, backbone, bird, birth, bone, bone marrow, carbon dioxide, cartilage, cells, characteristic, classify, cold-blooded, egg, feathers, fins, fish, gills, hair, human, invertebrate, joint, lungs, mammal, mammary glands, oxygen, reptile, ribs, scales, skeleton, skull, spine, tadpole, temperature, tissue, vertebrae, vertebrate, warm-blooded **Key comprehension skill:** Use a Table of Contents and Headings *Other suitable comprehension skills:* Cause and effect; compare and contrast; classify information; main idea and details; identify facts; elements of a genre; interpret graphs, charts, and diagrams; use a glossary and boldfaced terms **Key reading strategy:** Connect to prior knowledge *Other suitable reading strategies:* Ask and answer questions; summarize; visualize

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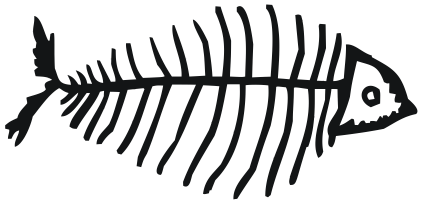

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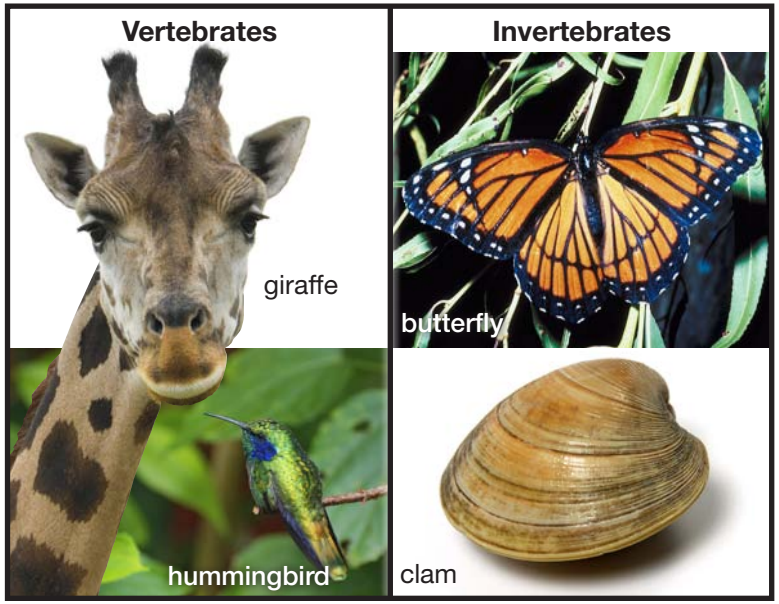
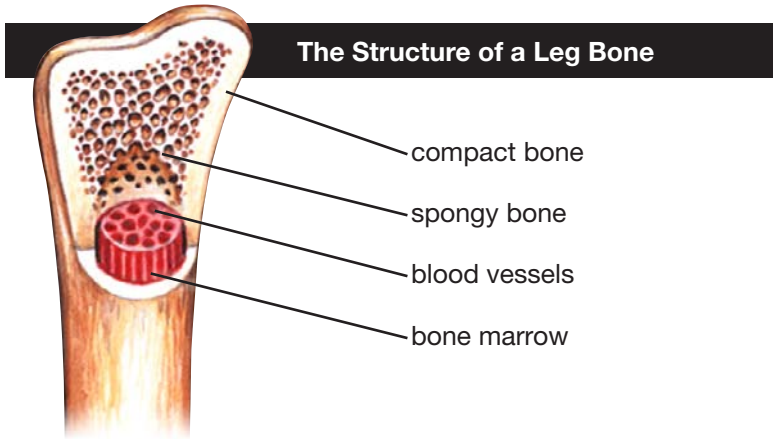
Introduction

Touch your elbow. Feel along the middle of your back. The hard objects you feel inside your body are bones. Bones hold up your body and protect organs such as your brain and heart.

Scientists **classify** animals into two groups. **Vertebrates** are animals with backbones. **Invertebrates** are animals without backbones.

As you read this book, you will find out what the five groups of vertebrates have in common, as well as what makes each group different.





A Closer Look at Bones

All bones are made of a hard type of body **tissue**. (Skin and muscles are other types of tissue.) Without bone tissue, your body would just be a big, soft blob.

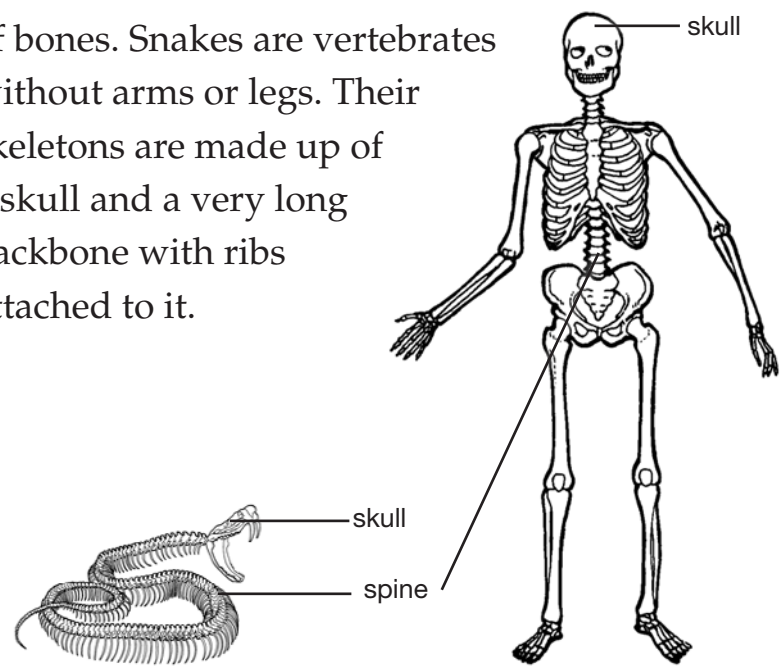
If you've ever seen a bone, you may think it looks dry and lifeless. But the bones inside your body are alive! Some bone cells help to repair broken bones. Others make blood cells. These bone cells are located in **bone marrow**, a special tissue in the center of some larger bones.

Blood travels in and out of living bone tissue, bringing oxygen and other nutrients and taking away waste products. Bones also have nerve tissue, especially in the outer layer, which is why it hurts so much if you break a bone.

The **skeleton** is the strong framework that supports and protects a vertebrate's body. The **spine**, or backbone, is the special feature of vertebrates. The spine is made up of a series of bones, called **vertebrae** (VER-teh-bray), which are attached to one another in a way that allows the backbone to bend.

At the top of the spine is a hard bony case called the **skull**. It holds and protects the body's control center—the brain.

The human skeleton has 206 bones. Other vertebrates have different numbers of bones. Snakes are vertebrates without arms or legs. Their skeletons are made up of a skull and a very long backbone with ribs attached to it.

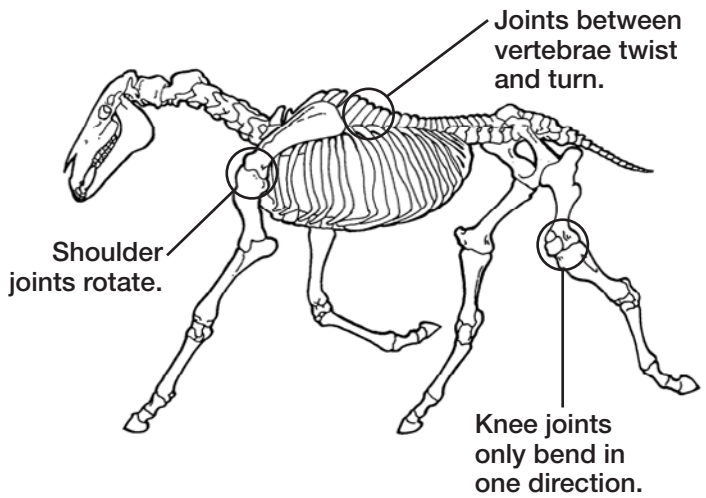


Snake Skeleton **Human Skeleton**

The ends of many bones are covered with softer tissue called **cartilage**. Cartilage is rubbery tissue that keeps the hard surfaces of bones from grinding against each other. Other parts of your body have cartilage, too. Feel your nose and ears, which are made of cartilage.

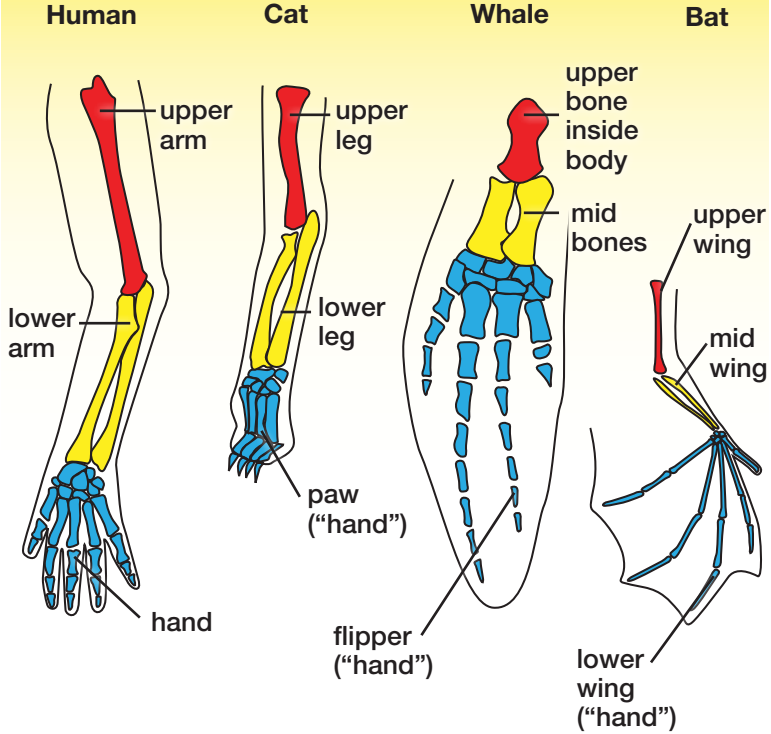
Joints are the places where bones meet. Joints allow vertebrates to move in different ways. Some joints, such as your knees, only bend in one direction. Other joints, such as your shoulders, rotate. Still others twist and turn. Cartilage helps all these joints to move smoothly.

Horse Skeleton



Different bones of vertebrates serve different purposes. Leg bones are designed to support the weight of an animal while it walks or runs. Most flying vertebrates have hollow, lightweight bones for greater ease of flight. Some smaller bones allow animals to move their feet, hands, flippers, or wings in precise ways to steer their bodies or handle objects such as food.

COMPARING BONES IN MAMMAL LIMBS



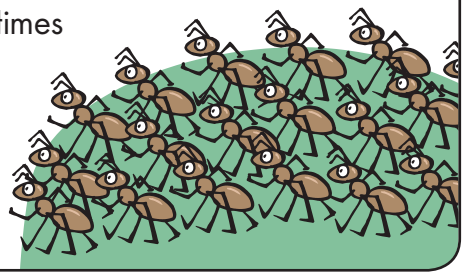
Classifying Vertebrates

So far, we have mentioned vertebrates and invertebrates as the two big animal groups. Scientists further divide both vertebrates and invertebrates into smaller groups of animals. Since this book is about animals with bones, we are going to study the five groups of vertebrates.

Each group has some **characteristics** in common with other groups as well as some special characteristics not found in other groups. And even within each of the five groups of vertebrates, the types of animals differ from each other.

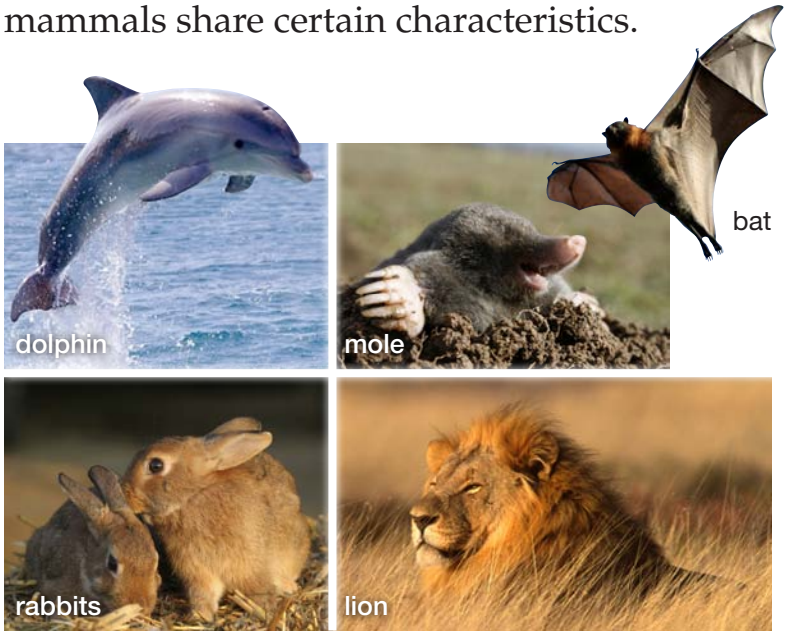
WOWSER!

There are many more kinds of invertebrates than vertebrates in the world. Insects make up the largest group of invertebrates. There are about 16 times as many species of insects as all species of vertebrates combined. That's a lot of insects!



Mammals

When you think of animals, **mammals** might be the first group that comes to mind. Mammals include dogs, giraffes, whales, bats, mice, humans, and many other animals. All mammals share certain characteristics.



All these vertebrates are mammals.

Math Moment

A small mammal called a *vole* can have a litter of babies every month. The oldest-known vole lived for 18 months. If that vole had a litter every month of its life and the average litter size was 8, how many young would the vole have produced during its lifetime?

- Mammals have hair on their bodies. Some mammals, like bears, are covered with thick hair or fur. Other mammals, such as elephants, only have sparse body hair. Some marine (water) mammals, such as dolphins and porpoises, are born with a little hair on their snouts. The hair falls out soon after birth.

- Mammals are warm-blooded. Their internal body temperature does not go up and down much when the temperature outside their body changes.

- Mammals have a large muscle, called a *diaphragm* (DIE-uh-fram), that is used to bring air into their lungs. The lungs are a pair of breathing organs in the chest. Breathing in, or inhaling, draws in an important gas, called *oxygen*, from the surrounding air. Breathing out, or exhaling, releases a waste gas called *carbon dioxide* into the air.

- Mammals have mammary glands that produce milk to feed their young. Mammals that give birth to many young have up to eleven pairs of mammary glands.

- Almost all mammals give birth to live young.

Birds

You can probably recognize a **bird** when you see one. But do you know what all birds have in common?

All these vertebrates are birds.

Do You Know?

Not all birds can fly. Ostriches and emus, which live on land, have developed the ability to run fast. Penguins, which have adapted to life in the ocean, are excellent swimmers.

- Like mammals, birds are warm-blooded.
- Birds are the only modern-day animals with feathers covering their bodies. Feathers are made of the same material as hair, horns, beaks, hooves, and nails.
- Birds have wings instead of front legs. Birds are designed for flight.
- Most birds have lightweight, hollow bones. Lightweight bones allow birds to fly more easily.
- Birds have beaks, and they have no teeth. Birds use their beaks to eat, groom themselves, feed their young, and find and move objects. Some birds also use their beaks to kill other animals.
- Like mammals, birds breathe with lungs.
- Birds lay eggs that have hard, waterproof shells. Eggs come in different sizes, shapes, and colors.

Fish

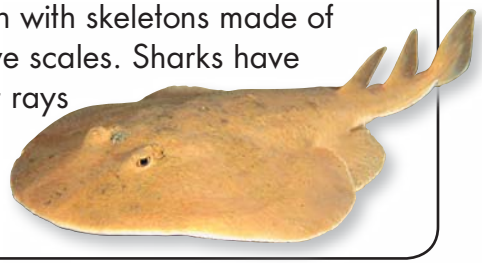
In the same way that most birds are adapted for flight, **fish** are adapted to life in water.

Fish have backbones, which makes them vertebrates, too. Let's learn about the characteristics that fish share.

All these vertebrates are fish.

Do You Know?

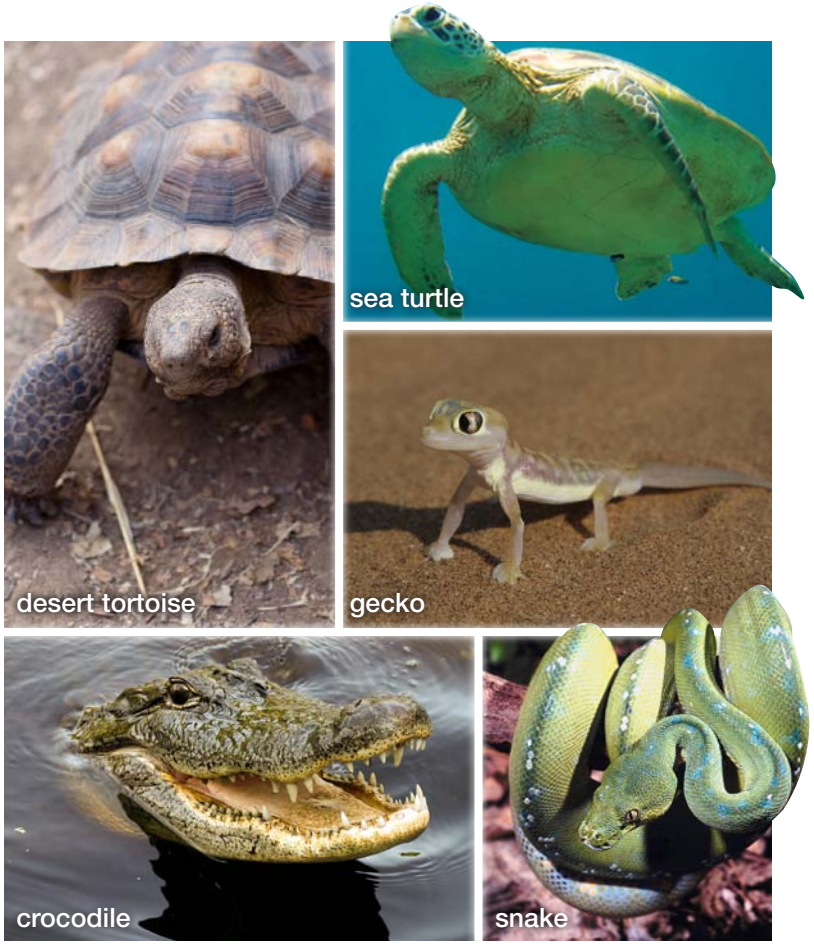
Most fish that have bones also have scales. But sharks and other fish with skeletons made of cartilage do not have scales. Sharks have rough skin, but most rays and some skates have smooth skin.



- Fish are cold-blooded animals. Their body temperature changes with the temperature of the water surrounding their body.
- Fish are the only group of vertebrates that live in water their entire lives. Some live in the fresh water of lakes, ponds, rivers, and streams. Other fish live in salt water in oceans. Some, like salmon, live in fresh and salt water at different stages of their lives.
- Fish have fins and strong tails for swimming. Most fish use their fins to steer, or guide their movement. They use their tails to move, or propel, their bodies through the water.
- Most fish have scales covering their bodies. Scales are small, thin, hard plates that overlap each other.
- Fish breathe with gills instead of lungs. Gills are breathing organs that take oxygen from water. Blood that passes through the gills releases carbon dioxide gas into water.
- Most fish lay eggs, but some fish with backbones made of cartilage give birth to live young.

Reptiles

Reptiles, another large group of vertebrates, may live in water or on land. This group includes alligators, snakes, lizards, and turtles. Reptiles share some characteristics with other groups of vertebrates, and they are different in other ways.



All these vertebrates are reptiles.

- Reptiles have dry, scaly skin that is waterproof.
- Reptiles are cold-blooded. If they're too cold, they bask in the sun to warm up. If they become too warm, they seek shade or water to cool off. Lizards sometimes cool off by lifting their bodies off the ground as if they're doing pushups. Crocodiles release body heat by resting with their mouths open.
- Reptiles breathe with lungs.
- Most reptiles lay eggs, but unlike bird eggs, which have hard shells, reptile eggs are leathery or soft. Some reptiles, including rattlesnakes, give birth to live young. Those young are surrounded by eggs while inside their mother, but the shells dissolve before birth.
- Baby reptiles look like their parents from the time they hatch or are born.


alligator

Amphibians

Amphibians are the last main group of vertebrates. Frogs, toads, and salamanders are some well-known amphibians. Let's learn about the characteristics that amphibians share.


toad


newt


salamander


poison arrow frog

All these vertebrates are amphibians.

WOWSER!

A few unusual amphibians remain tadpoles all their lives. They keep their gills instead of developing lungs.


axolotl

- Amphibians live in places that are damp.
- Amphibians have smooth, moist skin.
- Amphibians are cold-blooded.
- Most amphibians lay eggs that have a jellylike covering. The eggs are usually laid in water so they won't dry out.
- Many baby amphibians are born in water. They look different from their parents when they emerge from eggs. Baby amphibians, called *tadpoles*, use fins and tails to move through the water. Most amphibians' bodies will change form as they develop. They will lose their tails and grow legs as they become adult amphibians.
- Most amphibians breathe with gills during the tadpole stage. As they grow and change, these amphibians lose their gills and grow lungs. Some amphibians also breathe through their skin.

tadpoles

Comparing Vertebrates

We can compare and contrast the different groups of vertebrates. Look at each group's description in the chart on this page. Then match them with the pictures on the next page. Notice the characteristics that different groups of vertebrates share, and notice which ones are different.

Think or write in the numbers of the pictures that match each group.

Vertebrate Group	Body Covering	Breathing Organs	Warm- or Cold-Blooded	Young
Mammals _____	hair or fur (a lot or a little)	lungs	warm-blooded	live birth (most); eggs (a few)
Birds _____	feathers (scales on feet)	lungs	warm-blooded	eggs
Fish _____	scales (most)	gills	cold-blooded	eggs
Reptiles _____	scales	lungs	cold-blooded	eggs (most); live birth (some)
Amphibians _____	smooth, moist skin	gills when young; lungs when adults (most)	cold-blooded	eggs

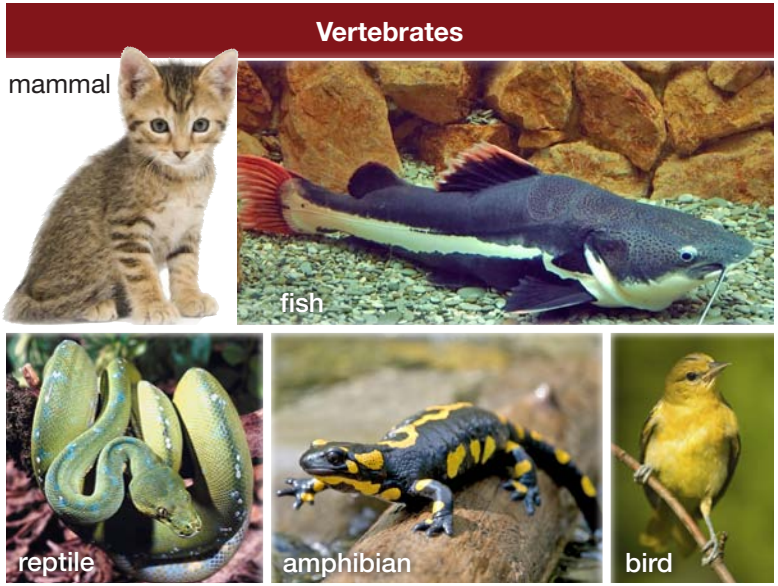
Do You Know?

A turtle's shell is part of its skeleton. The shell contains the spinal column, ribs, and flat, bony plates between the ribs, called *scutes*. The shell is covered with thick skin that is made of the same material as beaks and hooves.

Conclusion

In this book, you've learned about the difference between vertebrates (animals with backbones) and invertebrates (animals without backbones). You've also learned about the five groups of vertebrates and the main characteristics of each group. Now you know about their bones, their different body coverings, and much more.

The next time you see animals in nature or in a zoo, ask yourself whether they are vertebrates or invertebrates. Recall what you have read as you figure out the group each vertebrate belongs to. What features do you share?



Glossary

amphibians cold-blooded vertebrates that generally spend some time in water and some time on land (p. 18)

bird a warm-blooded vertebrate with a beak, wings, and feathers (p. 12)

bone marrow spongy material in the center of bones that produces blood cells (p. 5)

cartilage a tough, rubbery tissue found in vertebrates that provides support to the skeleton (p. 7)

characteristics physical features that help identify a thing or group of things (p. 9)

classify to assign to a category (p. 4)

fish vertebrates that live in water, swim, have gills and fins, and are usually covered with scales (p. 14)

invertebrates animals without backbones (p. 4)

joints places where bones connect or join together (p. 7)

mammals warm-blooded vertebrates with hair or fur that nurse their young and have babies that are born live (p. 10)

reptiles cold-blooded vertebrates that are covered with scales or horny plates (p. 16)

skeleton the framework of bones and cartilage that supports and protects the body of a vertebrate (p. 6)

skull the main bone structure of the head (p. 6)

spine the backbone, or vertebral column (p. 6)

tissue a group of cells in an organism that are similar in form and do a certain job (p. 5)

vertebrae the bones that make up the spine, or backbone (p. 6)

vertebrates animals with backbones (p. 4)