

WORD STUDY

Each bone in the spine is called a *vertebra*. The plural is *vertebrae*. That is why animals with spines are called vertebrates.

Animal Groups

There are millions of types of animals on Earth. Scientists classify animals based on shared traits such as whether or not an animal has a spine.

A spine is a line of many small bones that runs down the middle of an animal's back. An animal with a spine is called a **vertebrate**.

An **invertebrate** is an animal that not only has no spine—it does not have any bones at all! Invertebrates are more common than vertebrates.

Vertebrates and invertebrates are divided into smaller groups. Animal classes are groups of animals that are organized by ways they are alike, such as birds or fish.



Invertebrates

Invertebrates can be found all over Earth. Most are small, such as insects. A few become very large. For example, the giant squid can grow as long as a school bus.

Instead of bones, invertebrates have other structures that hold up and protect their bodies. Many have a thin, hard covering called an exoskeleton. Lobsters, grasshoppers, and spiders have exoskeletons. Some, such as snails and clams, have hard outer shells. Invertebrates such as sea stars have shells inside their bodies! A few, such as jellies, depend on the water in which they live to support their bodies.

The biggest group of invertebrates is the arthropods. There are over 800,000 named species of arthropods. Arthropods have exoskeletons, bodies with more than one segment, and legs with joints. Spiders, ants, centipedes, and shrimp are all arthropods. The photos below show some of the many kinds of arthropods.



The joints in this spider's legs help it run quickly. The spider can also use its legs to grab things or climb up a single strand of web.



Centipedes have one pair of jointed legs on each body section.



Hermit crabs use found shells as extra protection, especially when they are molting. As hermit crabs grow, they have to keep finding bigger shells in which to live.

WORD STUDY

In Greek, *exo* means "outer." Therefore, an exoskeleton is a skeleton on the outside of the body. In order to grow, animals with exoskeletons must molt, or shed their outer layer.

CAREER CONNECTION

Interested in helping animals? Veterinarians are doctors for pets and other animals. A veterinarian learns about how animals' bodies function to help them remain healthy.



Vertebrates

Vertebrates are the animals you are probably most familiar with. Scientists organize vertebrates into five classes: mammals, birds, reptiles, amphibians, and fish.

Mammals

Mammals are a class of vertebrates that have fur or hair. Mice, dogs, elephants, and people are all mammals. Most mammals are born live, meaning not hatched from an egg. Female mammals make milk to feed their young. They care for their young until the young can find food on their own. All mammals have lungs, not gills. Mammals that live in the water, such as whales and dolphins, swim to the surface to breathe air.

Mammals are warm-blooded. This means that their body temperature does not change much. Being warm-blooded allows mammals to live in many places. Polar bears live in the cold Arctic. Tigers live in swamps, grasslands, and rain forests.



A mammal's first food is milk from its mother.



A dolphin breathes air into its lungs through a hole in the top of its head.

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Vertebrates—Birds

Birds are another familiar group of vertebrates. **Birds** have feathers, two wings, and two legs. Most birds have hollow bones, which make them very light. This makes it easier for them to fly. Like mammals, birds use lungs to breathe air and are warm-blooded. All birds lay eggs. Most birds lay their eggs in a nest and then keep the eggs warm until they hatch.

Although all birds have wings, not all birds can fly. Penguins use their wings as rudders and propellers to help them move easily through water. Ostriches use their wings to keep warm at night.



Some birds, such as parrots and ravens, are considered very intelligent. They can even learn to speak.



Most ducks feed and care for their young until the young can find food on their own.

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FACT CHECKER

"Cold-blooded" does not mean reptiles are cold. They get their body heat from their environment. In hot environments, reptiles can have warmer blood than mammals.



Vertebrates—Reptiles

Reptiles are the vertebrates most closely related to birds. Like birds, they have lungs. Also like birds, most reptiles lay eggs. However, some, such as the boa constrictor, give birth to live young. Reptiles do not have wings or feathers, and they cannot fly. Almost all reptiles are cold-blooded. Their body temperature changes with the temperature of their environment.

Some reptiles live on land, and some live in water. Many reptiles, such as crocodiles, are comfortable both on land and in water. They are comfortable because reptiles are covered in waterproof scales that keep their bodies from drying out.

Common reptiles include turtles, crocodiles, alligators, snakes, and lizards.



Many reptiles have four legs, but some, such as snakes, do not have any!



At over 70 kilograms (154 pounds), the alligator snapping turtle is one of the largest freshwater turtles.

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Vertebrates—Amphibians

Amphibians are vertebrates that live part of their lives in water and part on land. Most amphibians start life underwater. A young amphibian that lives in the water is called a larva or tadpole. Larvae have gills and look like fish. As they get older, amphibians go through metamorphosis, which means their body form changes. Some amphibians, such as newts, grow legs. Others, such as caecilians, look like worms or snakes.

When they live on land, amphibians breathe air. Most, but not all, amphibians grow lungs. Some amphibians can also breathe through their skin. Like most reptiles, amphibians are cold-blooded. Unlike reptiles, amphibians do not have scales.

Frogs, toads, salamanders, caecilians, and newts are all amphibians.



Some adult amphibians, such as this frog, can breathe using their lungs or through their skin.



A salamander is an amphibian that lives near water or other cool, damp places.



This caecilian is an amphibian that lives mostly in the ground.

MAKE CONNECTIONS

Jump to *Animal Life Cycles* to learn about amphibian metamorphosis.





Lamprey have no jaws. They have a mouth like a straw with teeth inside to suck up prey or to suck blood!



A flat shape and smooth skin help fish such as this stingray move through the water.

Vertebrates—Fish

Fish are the last class of vertebrates. There are about 32,000 different species of fish. Sharks, eels, and rays are some kinds of fish. All **fish** have gills. They spend their entire lives in water. Fish live almost everywhere there is water. They live in fresh water and salt water, in streams and oceans, and in shallow water and deep water. Most fish are covered in scales, feel slimy, and lay eggs. Some sharks give birth to live young.

Almost all fish are cold-blooded. Some fish, however, are able to maintain their body temperatures like warm-blooded organisms.

Different fish grow to different sizes and eat different foods. Eels can grow to be 10 feet long, but some carp are no bigger than your pinky fingernail. Sharks eat only meat, but rainbowfish eat plants. Other fish strain tiny floating organisms from the water for food.

Animal Life Cycles

Metamorphosis

Some baby animals look like smaller versions of their parents. Puppies, for example, look like small dogs, and foals look like small horses. Other animals look different at different stages of life. Some animals change shape through a process called metamorphosis. Most insects and amphibians undergo metamorphosis.

Classification of Plants

How a plant grows and reproduces is its life cycle. Plants have male parts and female parts. These parts make special cells that join together to make a new plant.

Inside a cherry tree's flowers, male parts make pollen and female parts make eggs. **Pollination** occurs when bees carry pollen to another plant's egg. They meet to form a seed. Cherries are the fruit that forms around these seeds. Sometimes an animal eats the fruit. It later deposits the seed in its droppings. When conditions are right, the seed can germinate, or begin to grow. A new cherry tree will grow from the seed.

Life Cycle of a Cherry Tree

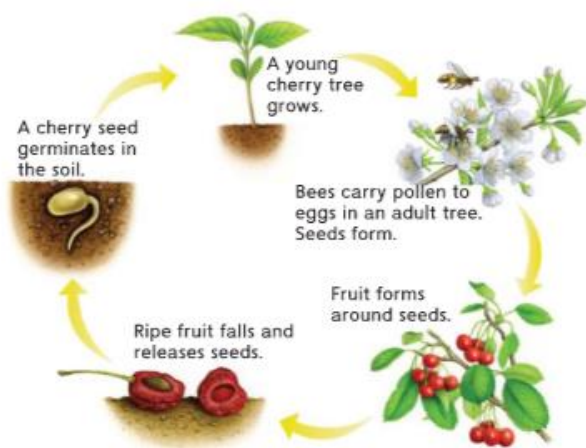


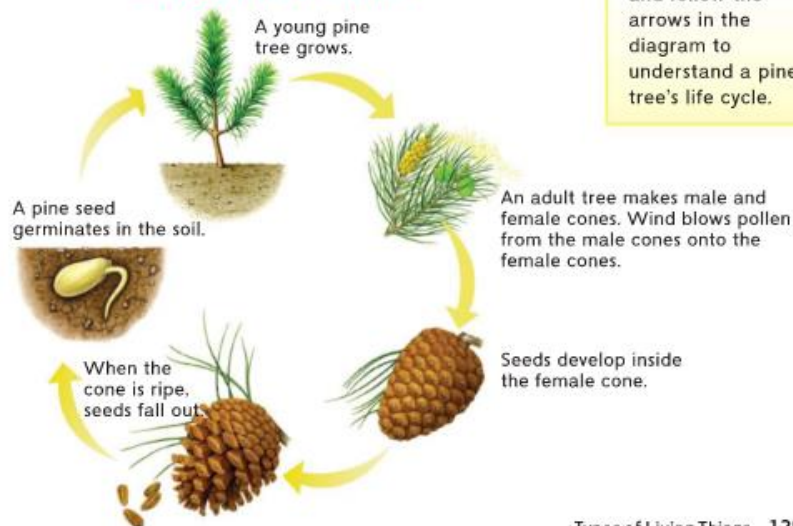
Photo by Stephen Ausmus, USGS/ARS

Reproducing with Cones

A pine tree's life cycle is similar to a flowering plant's, but pine trees do not have flowers. Instead, they form seeds inside cones. Pollination takes place when the wind blows pollen from a male cone into a female cone. Seeds develop in the female cones. When the seeds are ready, the cone opens, and wind blows the seeds to new places.

Plants that produce cones for reproduction are called **conifers**. Conifers have needle-shaped leaves. Most conifers keep their needles year-round. Those plants are often called evergreens. However, not all conifers are evergreens. For example, the western larch's needles turn yellow and drop off during autumn.

Life Cycle of a Pine Tree



DID YOU KNOW?

Lodgepole pine cones stay closed until the great heat of a forest fire pops them open. Their seeds have space to grow in the open land the fire leaves behind.

SKILL BUILDER

Read a Diagram

Read the labels and follow the arrows in the diagram to understand a pine tree's life cycle.

From Seed to Plant

If you have ever eaten peas, corn, or nuts, you have eaten seeds. Inside each seed is an embryo, a young plant ready to start growing. Also inside the seed is food for the embryo to use as it grows. The outside of a seed is tough, to protect the embryo.



When conditions are right, a seed will germinate. To germinate means to start growing. It waits until the temperature is right and the soil is wet enough. Some seeds wait for months or years before germinating.

A germinating embryo soaks up water until it swells and bursts through the seed's outer covering. Over time, the seed grows to be a mature plant.



Reproducing Without Seeds

Some plants reproduce without making seeds. Ferns reproduce by making **spores**, which are tiny particles similar to simple seeds. However, ferns do not go through pollination before making spores. Spores blow in the wind and fall on the ground. Then, they grow into a plant stage that undergoes a process like pollination. After that, a new fern grows.



New stems and leaves can grow from potato "eyes."

New plants can also grow from parts of plants. The part of a potato plant that we eat is a tuber. A **tuber** is a large underground stem. We call the small white buds on potatoes "eyes." New stems and leaves can grow from these buds. Other plants, such as onions, can grow from an underground stem called a bulb. A new basil plant can grow from a stem or a leaf that is placed in water.

Life Cycle of a Fern

