

Birds and Mammals



chapter preview

sections

1 Birds

2 Mammals

Lab Mammal Footprints

Lab Bird Counts



Virtual Lab How are birds adapted to their habitat?

More Alike than Not!

Birds and mammals have adaptations that allow them to live on every continent and in every ocean. Some of these animals have adapted to withstand the coldest or hottest conditions. These adaptations help to make these animal groups successful.

Science Journal List similar characteristics of a mammal and a bird. What characteristics are different?

Start-Up Activities



Bird Gizzards

You may have observed a variety of animals in your neighborhood. Maybe you have watched birds at a bird feeder. Birds don't chew their food because they don't have teeth. Instead, many birds swallow small pebbles, bits of eggshells, and other hard materials that go into the gizzard—a muscular digestive organ. Inside the gizzard, they help grind up the seeds. The lab below models the action of a gizzard.

1. Place some cracked corn, sunflower seeds, nuts or other seeds, and some gravel in an old sock.
2. Roll the sock on a hard surface and tightly squeeze it.
3. Describe the appearance of the seeds after rolling.
4. **Think Critically** Describe in your Science Journal how a bird's gizzard helps digest the bird's food.



Preview this chapter's content and activities at bookc.msscience.com

FOLDABLES™ Study Organizer

Birds and Mammals Make the following Foldable to help you organize information about the behaviors of birds and mammals.

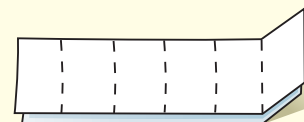
- STEP 1** Fold one piece of paper widthwise into thirds.



- STEP 2** Fold down 2.5 cm from the top. (Hint: From the tip of your index finger to your middle knuckle is about 2.5 cm.)



- STEP 3** Fold the rest into fifths.



- STEP 4** Unfold, lay the paper lengthwise, and draw lines along the folds. Label your table as shown.

	Birds	Mammals
Habitats		
Diet		
Movement		
Body Systems		
Young		

Make a Table As you read the chapter, complete the table describing the behaviors of birds and mammals.

Birds

as you read

What You'll Learn

- **Identify** the characteristics of birds.
- **Identify** the adaptations birds have for flight.
- **Explain** how birds reproduce and develop.

Why It's Important

Most birds demonstrate structural and behavioral adaptations for flight.

Review Vocabulary

thrust: for an object moving through air, the horizontal force that pushes or pulls the object forward

New Vocabulary

- contour
- feather
- down feather
- endotherm
- preening

Bird Characteristics

Birds are versatile animals. Geese have been observed flying at an altitude of 9,000 m, and penguins have been seen underwater at a depth of 543 m. An ostrich might weigh 155,000 g, while a hummingbird might weigh only 2 g. Some birds can live in the tropics and others can live in polar regions. Their diets vary and include meat, fish, insects, fruit, seeds, and nectar. Birds have feathers and scales and they lay eggs. Which of these characteristics is unique to birds?

Bird Eggs Birds lay amniotic (am nee AH tihk) eggs with hard shells, as shown in **Figure 1**. This type of egg provides a moist, protective environment for the developing embryo. The hard shell is made of calcium carbonate, the same chemical that makes up seashells, limestone, and marble. The egg is fertilized internally before the shell forms around it. The female bird lays one or more eggs usually in some type of nest, also shown in **Figure 1**. A group of eggs is called a clutch. One or both parents may keep the eggs warm, or incubate them, until they hatch. The length of time for incubation varies from species to species. The young are cared for by one or both parents.

Figure 1 This robin's round nest is built of grasses and mud in a tree.

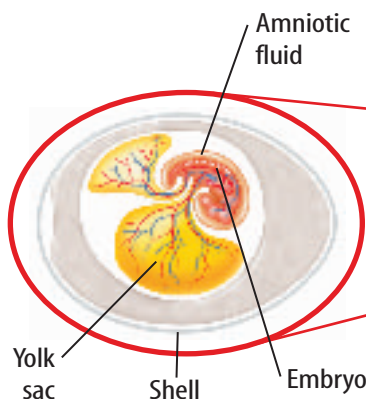
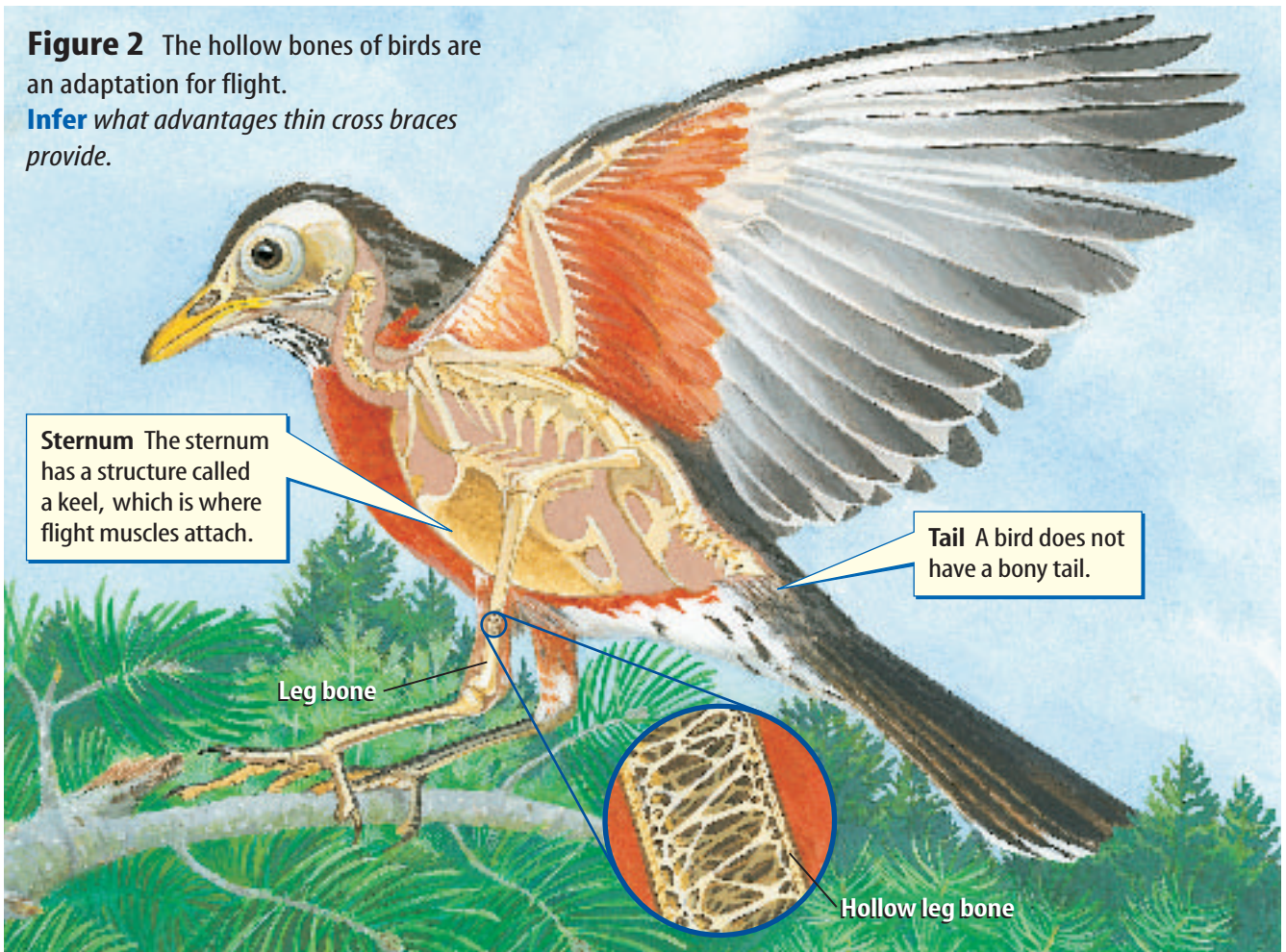


Figure 2 The hollow bones of birds are an adaptation for flight.

Infer what advantages thin cross braces provide.



Flight Adaptations People have always been fascinated by the ability of birds to fly. Flight in birds is made possible by their almost hollow but strong skeleton, wings, feathers, strong flight muscles, and an efficient respiratory system. Well-developed senses, especially eyesight, and tremendous amounts of energy also are needed for flight.

Hollow Bones One adaptation that birds have for flight is a unique internal skeleton, as shown in **Figure 2**. Many bones of some birds are joined together. This provides more strength and more stability for flight. Most bones of birds that fly are almost hollow. These bones have thin cross braces inside that also strengthen the bones. The hollow spaces inside of the bones are filled with air.

Reading Check What features strengthen a bird's bones?

A large sternum, or breastbone, supports the powerful chest muscles needed for flight. The last bones of the spine support the tail feathers, which play an important part in steering and balancing during flight and landing.



Star Navigation Many theories have been proposed about how birds navigate at night. Some scientists hypothesize that star positions help night-flying birds find their way. Research the location of the North Star. In your Science Journal, infer how the North Star might help birds fly at night.

Modeling Feather Function

Procedure


1. Wrap **polyester fiber** or **cotton** around the bulb of an **alcohol thermometer**. Place it into a **plastic bag**. Record its temperature in your **Science Journal**.
2. Place a second **alcohol thermometer** into a **plastic bag** and record its temperature.
3. Simultaneously submerge the thermometers into a **container of cold water**, keeping the top of each bag above the water's surface.
4. After 2 min, record the temperature of each thermometer.

Analysis

1. Which thermometer had the greater change in temperature?
2. Infer the type of feather that the fiber or cotton models.

Feathers Birds are the only animals that have feathers. Their bodies are covered with two main types of feathers—contour feathers and down feathers. Strong, lightweight **contour feathers** give a bird its coloring and smooth shape. These are also the feathers that a bird uses when flying. The contour feathers on the wings and tail help the bird steer and keep it from spinning out of control.

Have you ever wondered how ducks can swim in a pond on a freezing cold day and keep warm? Soft, fluffy **down feathers** provide an insulating layer next to the skin of adult birds and cover the bodies of young birds. Birds are **endotherms**, meaning they maintain a constant body temperature. Feathers help birds maintain their body temperature, and grow in much the same way as your hair grows. Each feather grows from a microscopic pit in the skin called a follicle (FAH lih kul). When a feather falls out, a new one grows in its place. As shown in **Figure 3**, the shaft of a feather has many branches called barbs. Each barb has many branches called barbules that give the feather strength.

 **Reading Check** *Why are some young birds covered with down feathers?*

A bird has an oil gland located just above the base of its tail. Using its bill or beak, a bird rubs oil from the gland over its feathers in a process called **preening**. The oil conditions the feathers and helps them last longer.

Figure 3 Down feathers help keep birds warm. Contour feathers are the feathers used for flight, and the feathers that cover the body.

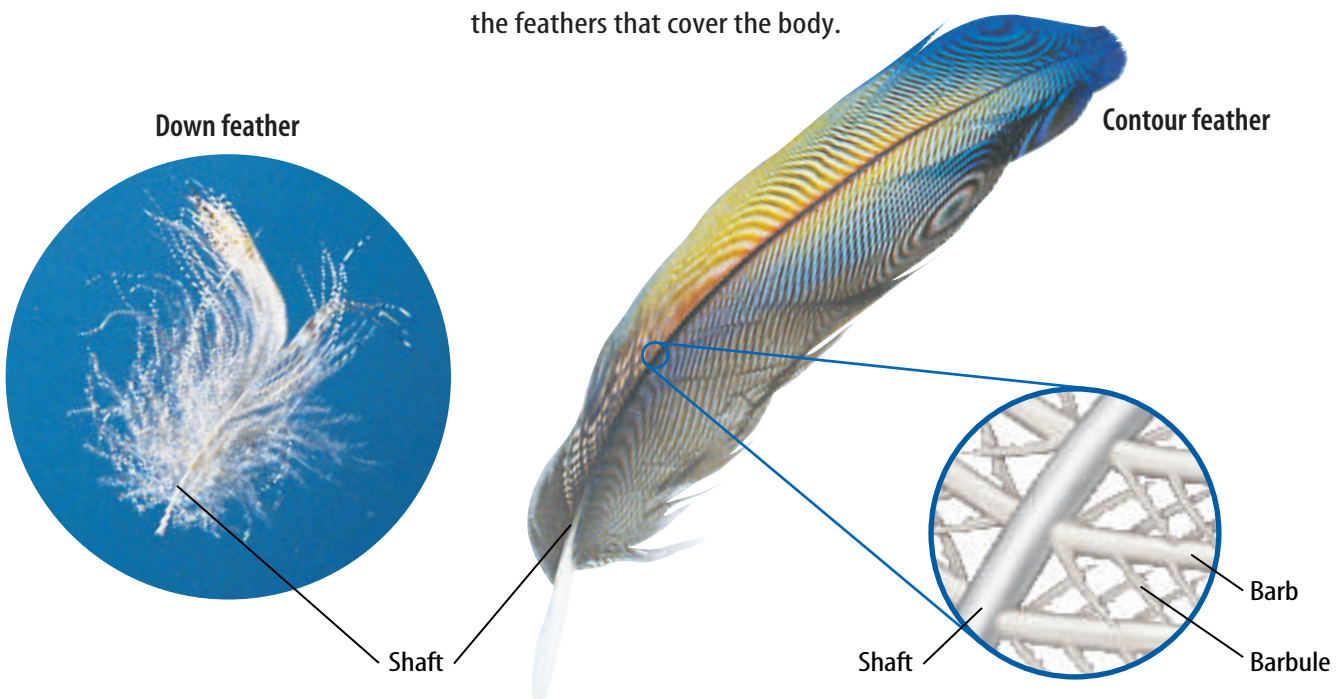
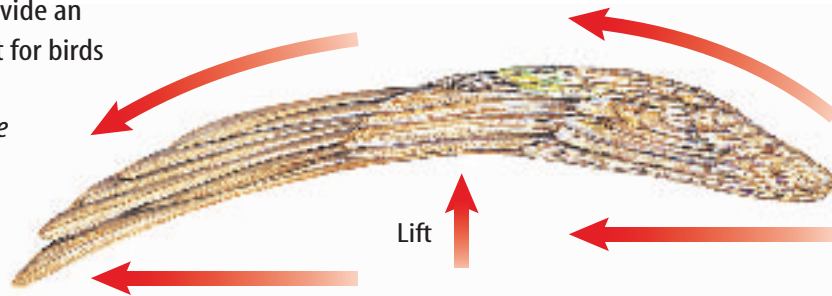


Figure 4 Wings provide an upward force called lift for birds and airplanes.

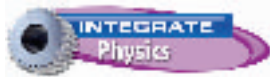
Describe how birds are able to fly.



Bald eagles are able to soar for long periods of time because their wings have a large surface area to provide lift.



This glider gets lift from its wings the same way a bald eagle gets lift.



Wings Although not all birds fly, most wings are adapted for flight. Wings are attached to powerful chest muscles. By flapping its wings, a bird attains thrust to go forward and lift to stay in the air. Its wings move up and down, as well as back and forth.

The shape of a bird's wings helps it fly. The wings are curved on top and flat or slightly curved on the bottom. Humans copied this shape to make airplane wings, as shown in **Figure 4**. When a bird flies, air moves more slowly across the bottom than across the top of its wings. Slow-moving air has greater pressure than fast-moving air, resulting in an upward push called lift. The amount of lift depends on the total surface area of the wing, the speed at which air moves over the wing, and the angle of the wing to the moving air. Once birds with large wings, such as vultures, reach high altitudes, they can soar and glide for a long time without having to beat their wings.

Wings also serve important functions for birds that don't fly. Penguins are birds that use their wings to swim underwater. Ostriches use their wings in courtship and to maintain their balance while running or walking.



Bird Pests Some birds have become pests in urban areas. Research to learn what birds are considered pests in urban areas, what effect they have on the urban environment, and what measures are taken to reduce the problems they create. Build a bulletin board showing your results.

Topic: Homing Pigeons

Visit bookc.msscience.com for Web links to information about homing pigeons.

Activity Name two past uses for homing pigeons, and write an advertisement for a new use in the future.

Body Systems

Whether they fly, swim, or run, most birds are extremely active. Their body systems are adapted for these activities.

Digestive System Because flying uses large amounts of energy, birds need large amounts of high energy foods, such as nuts, seeds, nectar, insects, and meat. Food is broken down quickly in the digestive system to supply this energy. In some birds, digestion can take less than an hour—for humans digestion can take more than a day.

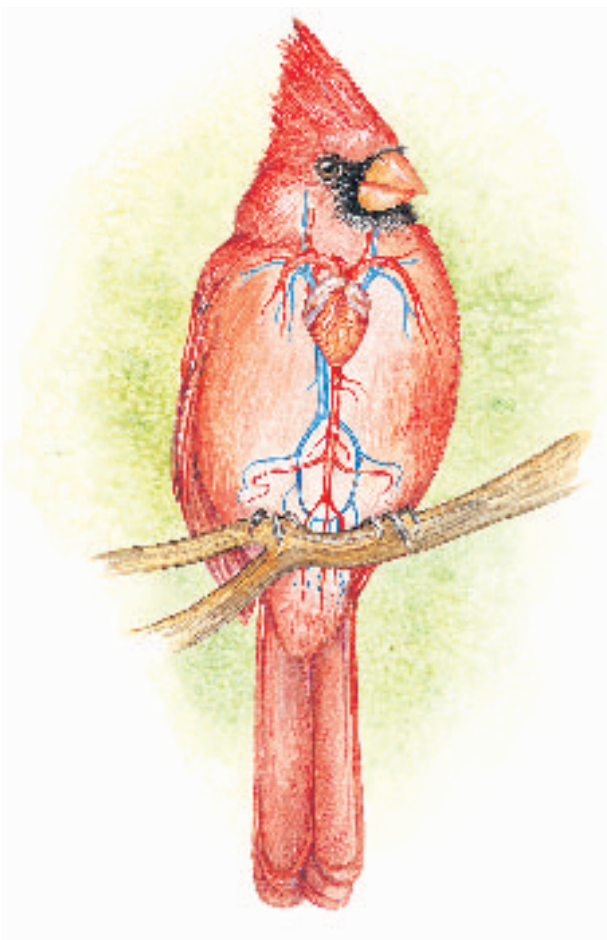
From a bird's mouth, unchewed food passes into a digestive organ called the crop. The crop stores the food until it absorbs enough moisture to move on. The food enters the stomach where it is partially digested before it moves into the muscular gizzard. In the gizzard, food is ground and crushed by small stones and grit that the bird has swallowed. Digestion is completed in the intestine, and then the food's nutrients move into the bloodstream.

Respiratory System Body heat is generated when energy in food is combined with oxygen. A bird's respiratory system efficiently obtains oxygen, which is needed to power flight muscles

and to convert food into energy. Birds have two lungs. Each lung is connected to balloonlike air sacs that reach into different parts of the body, including some of the bones. Most of the air inhaled by a bird passes into the air sacs behind the lungs. When a bird exhales, air with oxygen passes from these air sacs into the lungs. Air flows in only one direction through a bird's lungs. Unlike other vertebrates, birds receive air with oxygen when they inhale and when they exhale. This provides a constant supply of oxygen for the flight muscles.

Circulatory System A bird's circulatory system consists of a heart, arteries, capillaries, and veins, as shown in **Figure 5**. Their four-chambered heart is large compared to their body. On average, a sparrow's heart is 1.68 percent of its body weight. The average human heart is only 0.42 percent of the human's body weight. Oxygen-filled blood is kept separate from carbon dioxide-filled blood as both move through a bird's heart and blood vessels. A bird's heart beats rapidly—an active hummingbird's heart can beat more than 1,000 times per minute.

Figure 5 A bird's blood is circulated quickly so enough oxygen-filled blood is carried to the bird's muscles.





Owl



Hummingbird

The Importance of Birds

Birds play important roles in nature. Some are sources of food and raw materials, and others are kept as pets. Some birds, like the owl in **Figure 6**, help control pests, such as destructive rodents. Barn swallows and other birds help keep insect populations in check by eating them. Some birds, like the hummingbird in **Figure 6**, are pollinators for many flowers. As they feed on the flower's nectar, pollen collects on their feathers and is deposited on the next flower they visit. Other birds eat fruits, then their seeds are dispersed in the birds' droppings. Seed-eating birds help control weeds. Birds can be considered pests when their populations grow too large. In cities where large numbers of birds roost, their droppings can damage buildings. Some droppings also can contain microorganisms that can cause diseases in humans.

Uses of Birds Humans have hunted birds for food and fancy feathers for centuries. Eventually, wild birds such as chickens and turkeys were domesticated and their meat and eggs became a valuable part of human diets. Feathers are used in mattresses and pillows because of their softness and ability to be fluffed over and over. Down feathers are good insulators. Even bird droppings, called guano (GWAH noh), are collected from seabird colonies and used as fertilizer.

Parakeets, parrots, and canaries often are kept as pets because many sing or can be taught to imitate sounds and human voices. Most birds sold as pets are bred in captivity, but some wild birds still are collected illegally, which threatens many species.

Figure 6 In nature, some birds, like the owl on the left, help control pests. Others, like the hummingbird above, pollinate flowers. **Identify** other important uses of birds.

Figure 7

There are almost 9,000 living species of birds. Birds are subdivided into smaller groups based on characteristics such as beak size and shape, foot structure, and diet. Birds belonging to several groups are shown here.



BIRDS OF PREY This osprey has large claws that grasp and a sharp beak that tears flesh.

INSECT EATERS

This nuthatch has a pointed beak that can pry up bark or bore into wood to find insects.

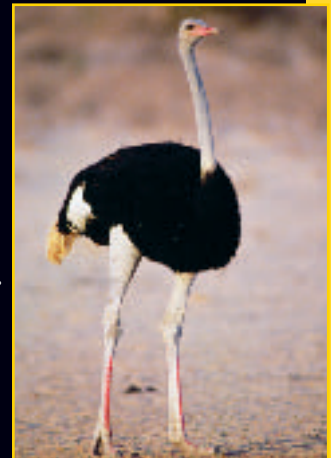


WATERBIRDS Wood ducks have webbed feet that propel them through the water.



FLIGHTLESS BIRDS

The ostrich evolved in places where there were once few mammal predators. Though they cannot fly, some flightless birds are fast runners.



SEED EATERS This cardinal's thick, strong beak can crack seeds.

WADING BIRDS

The great blue heron's long legs allow it to walk in shallow water.



Origin of Birds Birds, like those in **Figure 7**, have some characteristics of reptiles, including scales on their feet and legs. Scientists learn about the origins of most living things by studying their fossils; however, few fossils of birds have been found. Some scientists hypothesize that birds developed from reptiles millions of years ago.

Archaeopteryx (ar kee AHP tuh rihks)—a birdlike fossil—is about 150 million years old. Although it is not known that *Archaeopteryx* was a direct ancestor of modern birds, evidence shows that it had feathers and wings similar to modern birds. However, it had solid bones, teeth, a long bony tail, and clawed front toes, like some reptiles.

In 1991 in Texas, scientists discovered a fossil that had hollow bones and a well-developed sternum with a keel. *Protoavis* (proh toh AY vihs) lived about 225 million years ago. No fossil feathers were found with *Protoavis*. Scientists do not know if it was an ancestor of modern birds or a type of ground-living dinosaur. **Figure 8** shows an artist's idea of what *Archaeopteryx* and *Protoavis* may have looked like.



Figure 8 The first *Archaeopteryx* fossil was found more than 100 years ago. *Archaeopteryx*, to the left, is considered a link between reptiles and birds. *Protoavis*, below, may be an ancestor of birds.



section 1 review

Summary

Bird Characteristics

- Birds are feathered vertebrates. Females lay hard-shelled amniotic eggs, which hatch after an incubation period.
- Most birds are capable of flight, due to a hollow strong skeleton, wings, feathers, strong flight muscles, and efficient body systems.

Body Systems

- Birds have no teeth, but grind food in their gizzard.
- Birds take in oxygen while inhaling and exhaling, which provides more oxygen for flight.

Importance of Birds

- Birds pollinate plants, are a food source, keep pest populations low, and are used commercially.

Self Check

1. **Describe** the type of feather that helps birds maintain their body temperature.
2. **Sequence** Make a network-tree concept map about birds using the following terms: *birds, beaks, hollow bones, wings, eggs, adaptations for flight, feathers, and air sacs.*
3. **Think Critically** Hypothesize why most birds eat nuts, berries, insects, nectar, or meat, but not grass and leaves.

Applying Skills

4. **Venn Diagram** Draw a Venn diagram to compare and contrast the characteristics of birds that fly and birds that do not fly.
5. **Communicate** Many expressions mention birds, such as “proud as a peacock” and “wise as an owl.” Make a list of several of these expressions and then decide which are accurate.

Mammals

as you read

What You'll Learn

- **Identify** the characteristics of mammals and explain how they have enabled mammals to adapt to different environments.
- **Distinguish** among monotremes, marsupials, and placentals.
- **Explain** why many species of mammals are becoming threatened or endangered.

Why It's Important

Mammals, including humans, have many characteristics in common.

Review Vocabulary

gland: a cell or group of cells that releases fluid

New Vocabulary

- | | |
|-----------------|--------------------|
| ● mammal | ● marsupial |
| ● mammary gland | ● placental |
| ● omnivore | ● gestation period |
| ● carnivore | ● placenta |
| ● herbivore | ● umbilical cord |
| ● monotreme | |

Characteristics of Mammals

You probably can name dozens of mammals, but can you list a few of their common characteristics? **Mammals** are endothermic vertebrates that have hair and produce milk to feed their young, as shown in **Figure 9**. Like birds, mammals care for their young. Mammals can be found almost everywhere on Earth. Each mammal species is adapted to its unique way of life.

Skin and Glands Skin covers and protects the bodies of all mammals. A mammal's skin is an organ that produces hair and in some species, horns, claws, nails, or hooves. The skin also contains different kinds of glands. One type of gland found in all mammals is the mammary gland. Female mammals have **mammary glands** that produce milk for feeding their young. Oil glands produce oil that lubricates and conditions the hair and skin. Sweat glands in some species remove wastes and help keep them cool. Many mammals have scent glands that secrete substances that can mark their territory, attract a mate, or be a form of defense.



Figure 9 Mammals, such as this moose, care for their young after they are born.

Explain how mammals feed their young.

Figure 10 Mammals have teeth that are shaped specifically for the food they eat.



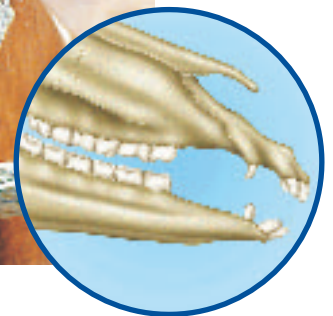
Bears have incisors to cut vegetation, canines to tear meat, and large, flat molars to crush and chew food.



A tiger easily can tear away the flesh of an animal because of large, sharp canine teeth and strong jaw muscles.



A horse's back teeth, called molars, are large. **Infer** how a horse chews.



Teeth Notice that each mammal in **Figure 10** has different kinds of teeth. Almost all mammals have specialized teeth. Scientists can determine a mammal's diet by examining its teeth. Front teeth, called incisors, bite and cut. Sometimes the teeth next to the incisors, called canine teeth, are well developed to grip and tear. Premolars and molars at the back of the mouth shred, grind, and crush. Animals, like the bear in **Figure 10**, and humans, have all four kinds of teeth. They eat plants and other animals, so they are called **omnivores**. A **carnivore**, like the tiger in **Figure 10**, has large canine teeth and eats only the flesh of other animals. **Herbivores**, such as the horse in **Figure 10**, eat only plants. Their large premolars and molars grind the tough fibers in plants.

Mini LAB

Inferring How Blubber Insulates

Procedure

1. Fill a self-sealing plastic bag about one-third full with vegetable shortening.
2. Turn another self-sealing plastic bag inside out. Carefully place it inside the bag with the shortening so that you are able to seal one bag to the other. This is a blubber mitten.
3. Put your hand in the blubber mitten and place it in ice water for 5 s. Remove the blubber mitten when finished.
4. Put your bare hand in the same bowl of ice water for 5 s.

Analysis

1. Which hand seemed colder?
2. Infer how a layer of blubber provides protection against cold water.



Figure 11 Herbivores, like this elk, have four-chambered stomachs and long intestinal tracts that contain microorganisms, which help break down the plant material.

Explain why herbivores need a longer digestive system than carnivores.

Hair All adult mammals have hair on their bodies. It may be thick fur that covers all or part of the animal's body, or just a few hairs around the mouth. Fur traps air and helps keep the animal warm. Whiskers located near the mouth help many mammals sense their environments. Whales have almost no hair. They rely on a thick layer of fat under their skin, called blubber, to keep them warm. Porcupine quills and hedgehog spines are modified hairs that offer protection from predators.

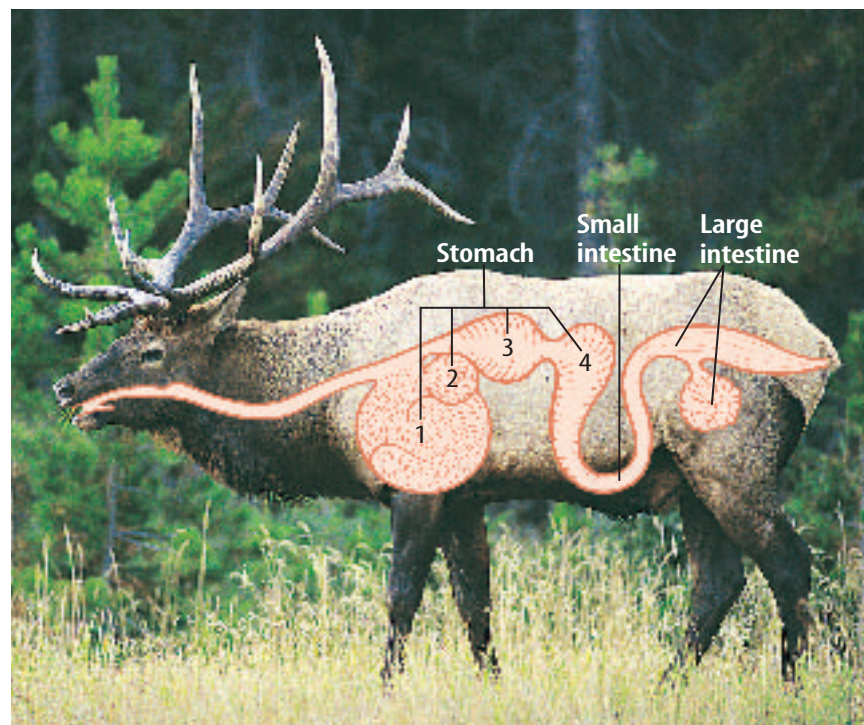
Body Systems

The body systems of mammals are adapted to their activities and enable them to survive in many environments.

Mammals have four-chambered hearts that pump oxygen-filled blood directly throughout the body in blood vessels. Mammals have lungs made of millions of microscopic sacs. These sacs increase the lungs' surface area, allowing a greater exchange of carbon dioxide and oxygen.

A mammal's nervous system consists of a brain, spinal cord, and nerves. In mammals, the part of the brain involved in learning, problem solving, and remembering is larger than in other animals. Another large part of the mammal brain controls its muscle coordination.

The digestive systems of mammals vary according to the kinds of food they eat. Herbivores, like the one shown in **Figure 11**, have long digestive tracts compared to carnivores because plants take longer to digest than meat.



Reproduction and Caring for Young All mammals reproduce sexually. Most mammals give birth to live young after a period of development inside the female reproductive organ called the uterus. Many mammals are nearly helpless, and sometimes even blind, when they are born. They can't care for themselves for the first several days or even years. If you've seen newborn kittens or human babies, you know they just eat, sleep, grow, and develop. However, the young of some mammals, such as antelope, deer, and elephants, are well developed at birth and are able to travel with their constantly moving parents. These young mammals usually can stand by the time they are a few minutes old. Marine mammals, such as the whales, shown in **Figure 12**, can swim as soon as they are born.



Reading Check *Is a house cat or a deer more developed at birth?*

During the time that young mammals are dependent on their female parent's milk, they learn many of the skills needed for their survival. Defensive skills are learned while playing with other young of their own kind. Other skills are learned by imitating adults. In many mammal species only females raise the young. Males of some species, such as wolves and humans, help provide shelter, food, and protection for their young.

Figure 12 When a whale is born, the female whale must quickly push the newborn whale to the water's surface to breathe. Otherwise, the newborn whale will drown.

Applying Science

Does a mammal's heart rate determine how long it will live?

Some mammals live long lives, but other mammals live for only a few years. Do you think that a mammal's life span might be related to how fast its heart beats? Use your ability to interpret a data table to answer this question.

Identifying the Problem

The table on the right lists the average heart rates and life spans of several different mammals. Heart rate is recorded as the number of heartbeats per minute, and life span is recorded as the average maximum years. When you examine the data, look for a relationship between the two variables.

Mammal Heart Rates and Life Spans

Mammal	Heart Rate (beats/min)	Life Span (years)
Mouse	400	2
Large dog	80	15
Bear	40	15–20
Elephant	25	75

Solving the Problem

1. Infer how heart rate and life span are related in mammals.
2. Humans have heart rates of about 70 beats per minute. Some humans may live for more than 100 years. Is this consistent with the data in the table? Explain.



Types of Mammals

Mammals are classified into three groups based on how their young develop. The three mammal groups are monotremes (MAH nuh treemz), marsupials (mar SEW pee ulz), and placentals (pluh SEN tulz).

Monotremes The duck-billed platypus, shown in **Figure 13**, is a monotreme. **Monotremes** are mammals that lay eggs with leathery shells. The female incubates the eggs for about ten days. After the young hatch, they nurse by licking the female's skin and hair where milk oozes from the mammary glands. Monotreme mammary glands do not have nipples.

Figure 13 A duck-billed platypus is a mammal, yet it lays eggs.

Explain why the duck-billed platypus is classified as a mammal.

Marsupials Many of the mammals that are classified as marsupials live in Australia, New Guinea, or South America. Only one type of marsupial, the opossum, lives in North America. **Marsupials** give birth to immature young that usually crawl into an external pouch on the female's abdomen. However, not all marsupials have pouches. Whether an immature marsupial is in a pouch or not, it instinctively crawls to a nipple. It stays attached to the nipple and feeds until it is developed. In pouched marsupials, the developed young return to the pouch for feeding and protection. Examples of marsupials are kangaroos and opossums, as shown in **Figure 14**, wallabies, koalas, bandicoots, and Tasmanian devils.

Figure 14 Opossums are the only marsupials found in North America. A joey, or young kangaroo, returns to its mother's pouch when danger is near.

A joey with its mother

Opossums



Placentals In **placentals**, embryos completely develop inside the female's uterus. The time during which the embryo develops in the uterus is called the **gestation period**. Gestation periods range from 16 days in hamsters to 650 days in elephants. Placentals are named for the **placenta**, an organ that develops from tissues of the embryo and tissues that line the inside of the uterus. The placenta absorbs oxygen and food from the mother's blood. An umbilical cord connects the embryo to the placenta, as shown in **Figure 15**. Several blood vessels make up the umbilical cord. Blood in the **umbilical cord** transports food and oxygen from the placenta to the embryo and removes waste products from the embryo. The female parent's blood doesn't mix with the embryo's blood. Examples of placentals are shown in **Table 1** on the following two pages.

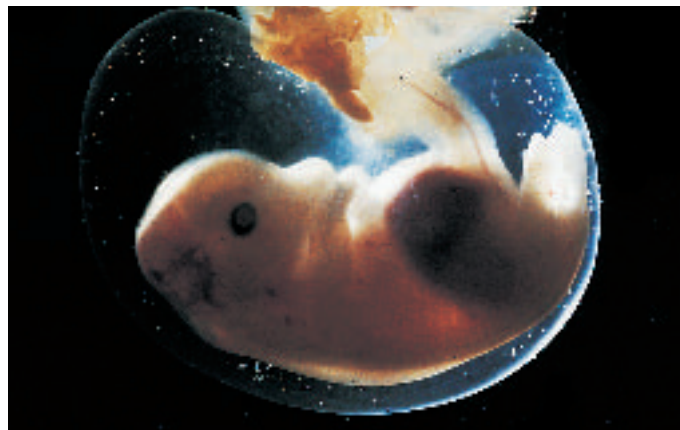


Figure 15 An unborn mammal receives nutrients and oxygen through the umbilical cord.

Compare and contrast placental, marsupial, and monotreme development.

Reading Check How does an embryo receive the things it needs to grow?

Some placental groups include unusual animals such as the manatee shown in **Figure 16**. Dugongs and manatees are aquatic mammals. They have no back legs, and their front legs are modified into flippers. Another group includes small, rabbit-like animals called hyraxes that have hooves and molars for grinding vegetation. The aardvark is the only member of its group. Aardvarks have tubelike teeth and dig termites for food. Many Southeast Asian islands are home to members of a group that includes gliding lemurs. Pangolins, another group of placentals, look like anteaters covered with scales.



Figure 16 A manatee swims slowly below the surface of the water.







Science  online







Topic: Manatee Habitats

Visit bookc.msscience.com for Web links to recent news or magazine articles about manatees and their habitats.

Activity Create a pamphlet about the manatees' habitat, their threats, and what people can do to help them.

Table 1 Placentals

Order	Examples		Major Characteristics
Rodentia (roh DEN chuh)	beavers, mice, rats, squirrels		one pair of chisel-like front teeth adapted for gnawing; incisors grow throughout life; herbivores
Chiroptera (ki RAHP tuh ruh)	bats		front limbs adapted for flying; active at night; different species feed on fruit, insects, fish, or other bats
Insectivora (ihn sek TIH vuh ruh)	moles, shrews, hedgehogs		small; feed on insects, earthworms, and other small animals; most have long skulls and narrow snouts; high metabolic rate
Carnivora (kar NIH vuh ruh)	cats, dogs, bears, foxes, raccoons		long, sharp canine teeth for tearing flesh; most are predators, some are omnivores
Primates (PRI maytz)	apes, monkeys, humans		arms with grasping hands and opposable thumbs; eyes are forward facing; large brains; omnivores
Artiodactyla (ar tee oh DAHK tih luh)	deer, moose, pigs, camels, giraffes, cows		hooves with an even number of toes; most are herbivores with large, flat molars; complex stomachs and intestines

Order	Examples		Major Characteristics
Cetacea (suh TAY shuh)	whales, dolphins, porpoises		one or two blowholes on top of the head for breathing; forelimbs are modified into flippers; teeth or baleen
Lagomorpha (la guh MOR fuh)	rabbits, hares, pikas		some with long hind legs adapted for jumping and running; one pair of large, upper incisors; one pair of small, peglike incisors
Pinnipedia (pih nih PEE dee uh)	sea lions, seals, walruses		marine carnivores; limbs modified for swimming
Edentata (ee dehn TAH tuh)	anteaters, sloths, armadillos		eat insects and other small animals; most are toothless or have tiny, peglike teeth
Perissodactyla (puh ris oh DAHK tih luh)	horses, zebras, tapirs, rhinoceroses		hooves with an odd number of toes; skeletons adapted for running; herbivores with large, grinding molars
Proboscidea (proh boh SIH dee uh)	elephants		a long nose called a trunk; herbivores; upper incisor teeth grow to form tusks; thick, leathery skin

Importance of Mammals

Mammals, like other organisms, are important in maintaining a balance in the environment. Carnivores, such as lions, help control populations of other animals. Bats help pollinate flowers and control insects. Other mammals pick up plant seeds in their fur and distribute them. However, mammals and other animals are in trouble today. As millions of wildlife habitats are destroyed for shopping centers, recreational areas, housing, and roads, many mammals are left without food, shelter, and space to survive. Because humans have the ability to reason, they have a responsibility to learn that their survival is related closely to the survival of all mammals. What can you do to protect the mammals in your community?

Figure 17 The *Dvinia* was an ancestor of ancient mammals.



Origin of Mammals About 65 million years ago, dinosaurs and many other organisms became extinct. This opened up new habitats for mammals, and they began to branch out into many different species. Some of these species gave rise to modern mammals. Today, more than 4,000 species of mammals have evolved from animals similar to the one in **Figure 17**, which lived about 200 million years ago.

section 2 review

Summary

Characteristics of Mammals

- Mammals have mammary glands, hair covering all or part of the body, and teeth specialized to the foods they eat.
- A mammal's body systems are well-adapted to the environment it lives in.

Types of Mammals

- There are three types of mammals: monotremes, which lay eggs; marsupials, which give birth to immature young that are nursed until developed, usually in a pouch; and placentals, which completely develop inside the female.

Importance of Mammals

- Mammals help maintain a balance in the environment. They are a food source, pollinators, and used commercially.

Self Check

1. **Describe** five characteristics of mammals and explain how they allow mammals to survive in different environments.
2. **Compare and contrast** birds and mammals.
3. **Describe** the differences between herbivores, carnivores, and omnivores.
4. **Classify** the following animals into the three mammal groups: whales, koalas, horses, elephants, opossums, kangaroos, rabbits, bats, bears, platypuses, and monkeys.
5. **Think Critically** How have humans contributed to the decrease in many wildlife populations?

Applying Math

6. **Solve One-Step Equations** The tallest land mammal is the giraffe at 5.6 m. Calculate your height in meters, and determine how many of you it would take to be as tall as the giraffe.

Mammal Footprints

Have you ever seen an animal footprint in the snow or soft soil? In this lab, you will observe pictures of mammal footprints and identify the mammal that made the footprint.

Real-World Question

How do mammal footprints differ?

Goals

- **Identify** mammal footprints.
- **Predict** where mammals live based on their footprints.

Materials

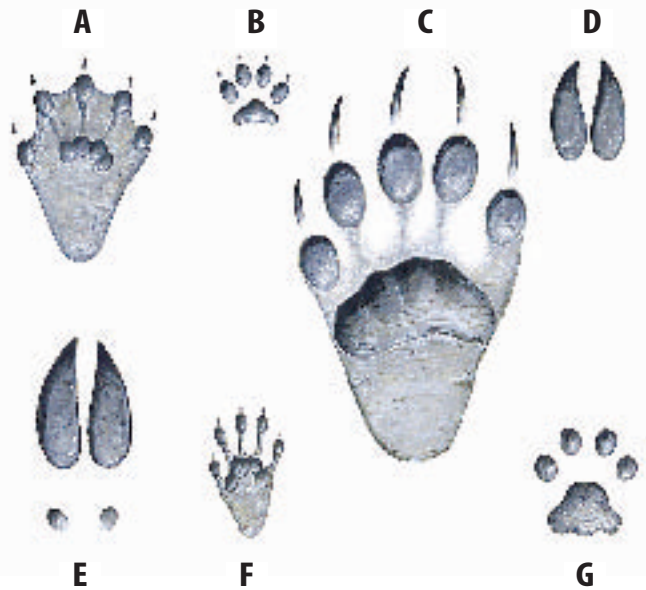
diagram of footprints

Procedure

1. Copy the following data table in your Science Journal.

Identifying Mammal Footprints		
Animal	Letter of Footprint	Traits of Footprint
Bear		
Beaver		
Cougar	Do not write in this book.	
Coyote		
Deer		
Moose		
Raccoon		

2. Compare and contrast the different mammal footprints in the above diagram.
3. Based on your observations, match each footprint to an animal listed in the first column of the data table.



4. **Write** your answers in the column labeled *Letter of Footprint*. Complete the data table.

Conclude and Apply

1. Which mammals have hooved feet?
2. Which mammals have clawed toes?
3. Which mammals have webbed feet?
4. **Explain** how the different feet are adapted to the areas in which these different mammals live.
5. What are the differences between track **B** and track **E**? How does that help you identify the track?

Communicating Your Data

Compare your conclusions with those of other students in your class. For more help, refer to the **Science Skill Handbook**.

Bird Counts

Goals

- **Research** how to build a bird feeder and attract birds to it.
- **Observe** the types of birds that visit your feeder.
- **Identify** the types of birds that you observe at your bird feeder.
- **Graph** your results and then communicate them to other students.

Data Source

Science  online

Visit book.msscience.com/internet_lab for Web links to more information about how to build a bird feeder, hints on bird-watching, and data from other students who do this lab.

Safety Precautions



Real-World Question

What is the most common bird in your neighborhood? Think about the types of birds that you observe around your neighborhood. What types of food do they eat? Do all birds come to a bird feeder? Form a hypothesis about the type of bird that you think you will see most often at your bird feeder.

Make a Plan

1. **Research** general information about how to attract and identify birds. Determine where you will make your observations.
2. **Search** reference sources to find out how to build a bird feeder. Do all birds eat the same types of seeds?
3. **Select** the type of feeder you will build and the seed you will use based on your research.
4. What variables can you control in this lab? Do seasonal changes, length of time, or weather conditions affect your observations?
5. What will you do to identify the birds that you do not know?

Follow Your Plan

1. Make sure your teacher approves your plan before you start.
2. **Record** your data in your Science Journal each time you make an observation of the birds at your bird feeder.



Cardinal



American Goldfinch

Analyze Your Data

1. **Write** a description of where you placed your feeder and when you made your bird observations.
2. **Record** the total number of birds you observed each day.
3. **Record** the total number of each type of bird species you observed each day.
4. **Graph** your data using a line graph, a circle graph, or a bar graph.



Black-capped Chickadee

Conclude and Apply

1. **Interpret Data** What type of bird was most common to your feeder?
2. **Explain** if all of your classmates' data agree with yours. Why or why not?
3. **Review** your classmates' data and determine if the location of bird observations affected the number of birds observed.
4. **Infer** if the time of day affected the number of birds observed. Explain.
5. **Infer** Many birds eat great numbers of insects. What might humans do to maintain a healthy environment for birds?



Birds at a feeder

Communicating Your Data

Find this lab using the link below. Post your data in the table provided. **Compare** your data to those of other students. Combine your data with those of other students and plot the combined data on a map to recognize patterns in bird populations.

 Science online

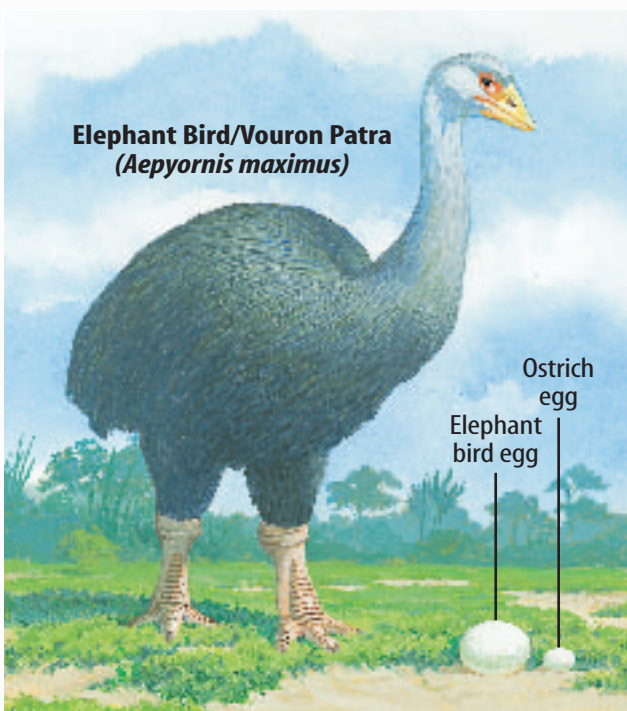
bookc.msscience.com/internet_lab

Eggciting Facts

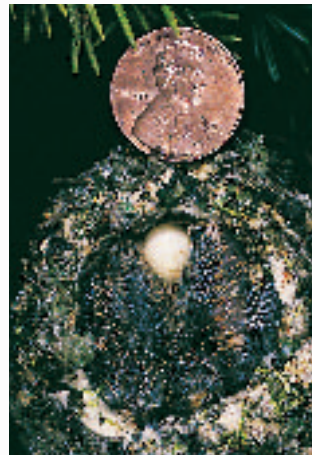
Did you know...

...**The ostrich lays the biggest egg** of all birds now living. Its egg is 15 cm to 20 cm long and 10 cm to 15 cm wide. The volume of the ostrich egg is about equal to 24 chicken eggs. It can have a mass from approximately 1 kg to a little more than 2 kg. The shell of an ostrich egg is 1.5 mm thick and can support the weight of an adult human.

...**The bird that lays the smallest egg** is the hummingbird. Hummingbird eggs are typically 1.3 cm long and 0.8 cm wide. The smallest hummingbird egg on record was less than 1 cm long and weighed 0.36 g.



Elephant Bird/Vouron Patra
(*Aepyornis maximus*)



Hummingbird
egg and nest



Ostrich egg

...**The elephant bird**, extinct within the last 1,000 years, laid an egg that was seven times larger than an ostrich egg. These eggs weighed about 12 kg. They were 30 cm long and could hold up to 8.5 L of liquid. It could hold the equivalent of 12,000 hummingbird eggs.

Applying Math How many elephant bird eggs would it take to equal a dog weighing 48 kg?

Graph It

Go to bookc.msscience.com/science_stats and research the egg length of an American robin, a house sparrow, a bald eagle, and a Canada goose. Make a bar graph of this information.

Reviewing Main Ideas

Section 1 Birds

1. Birds are endothermic animals that are covered with feathers and lay eggs.
2. Adaptations that enable most birds to fly include wings; feathers; a strong, light-weight skeleton; and efficient body systems.
3. Birds lay eggs enclosed in hard shells. All birds' eggs are incubated until they hatch.

Section 2 Mammals

1. Mammals are endothermic animals with fur or hair.
2. Mammary glands of female mammals can produce milk.
3. Mammals have teeth that are specialized for eating certain foods. Herbivores eat plants, carnivores eat meat, and omnivores eat plants and meat.
4. There are three groups of mammals. Monotremes lay eggs. Most marsupials have pouches for the development of their young. Placental offspring develop within a uterus and are nourished through a placenta.
5. Mammals are important in maintaining balance in the environment.

Visualizing Main Ideas

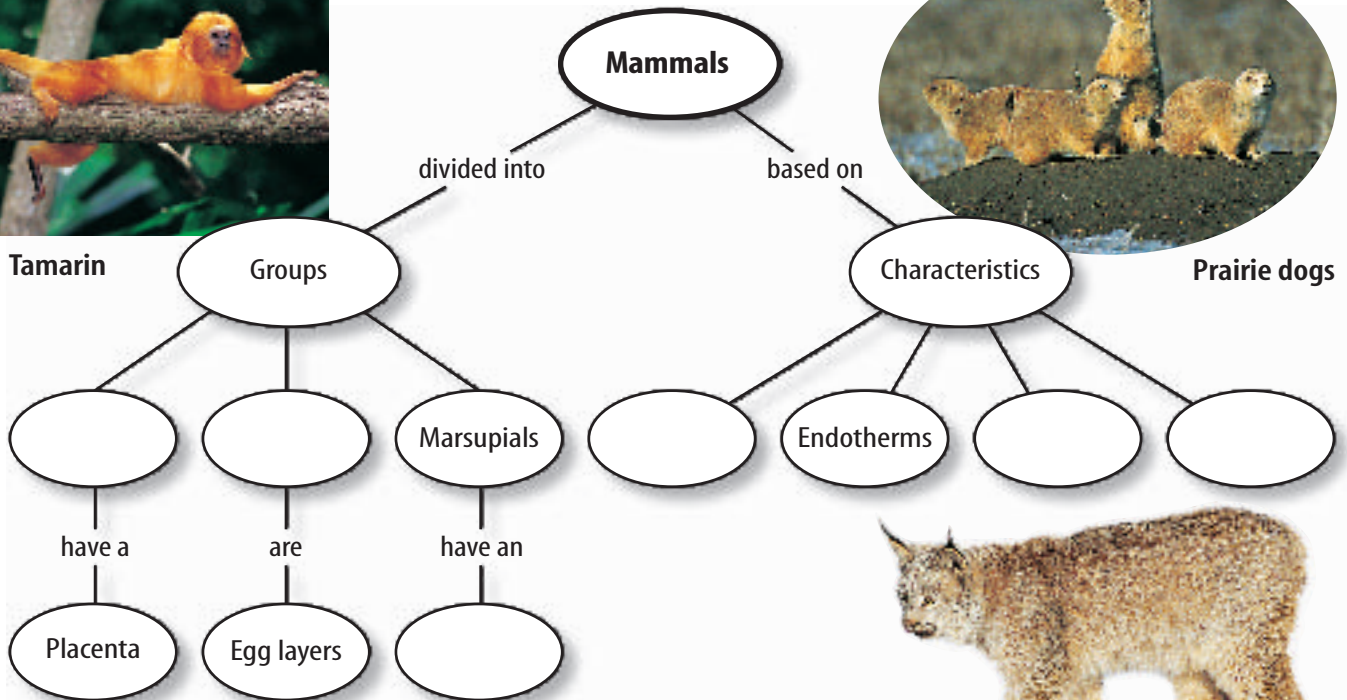
Copy and complete the following concept map on mammals.



Tamarin



Prairie dogs



Using Vocabulary

carnivore p.115	marsupial p.118
contour feather p.108	monotreme p.118
down feather p.108	omnivore p.115
endotherm p.108	placenta p.119
gestation period p.119	placental p.119
herbivore p.115	preening p.108
mammal p.114	umbilical cord p.119
mammary gland p.114	

Explain the difference between the vocabulary words in each of the following sets.

1. omnivore—carnivore—herbivore
2. contour feather—down feather
3. monotreme—marsupial
4. placenta—umbilical cord
5. endotherm—mammal
6. placental—monotreme
7. mammary gland—mammal
8. mammal—omnivore
9. endotherm—down feather
10. preening—down feather

Checking Concepts

Choose the word or phrase that best answers the question.

11. Which of the following birds has feet adapted for moving on water?
A) duck C) owl
B) oriole D) rhea
12. Birds do NOT use their wings for which of the following activities?
A) flying C) balancing
B) swimming D) eating
13. Which of these mammals lay eggs?
A) carnivores C) monotremes
B) marsupials D) placentals

14. Birds use which of the following organs to crush and grind their food?
A) crop C) gizzard
B) stomach D) small intestine
15. Which of the following mammals is classified as a marsupial?
A) cat C) kangaroo
B) human D) camel

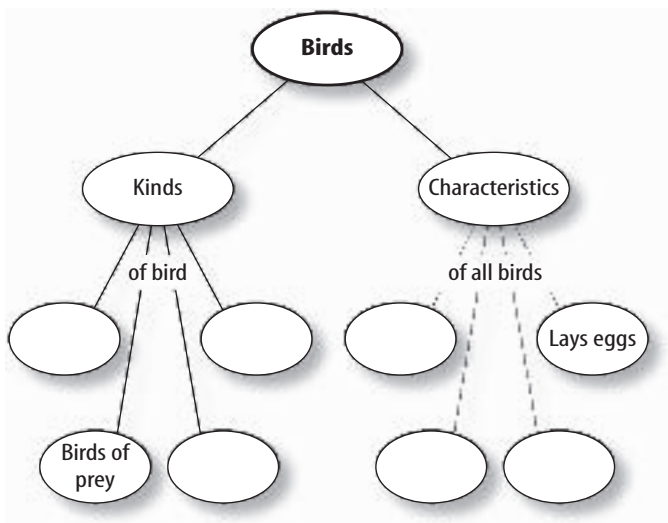
Use the photo below to answer question 16.



16. What are mammals with pouches, like the koala pictured above, called?
A) marsupials C) placentals
B) monotremes D) chiropterans
17. Which of the following have mammary glands without nipples?
A) marsupials C) monotremes
B) placentals D) omnivores
18. Teeth that are used for tearing food are called what?
A) canines C) molars
B) incisors D) premolars
19. Bird eggs do NOT have which of the following structures?
A) hard shells C) placentas
B) yolks D) membranes
20. Which of the following animals eat only plant materials?
A) carnivores C) omnivores
B) herbivores D) endotherms

Thinking Critically

- 21. **Compare and contrast** bird and mammal reproduction.
- 22. **Classify** You are a paleontologist studying fossils. One fossil appears to have hollow bones, a keeled breastbone, and a short, bony tail. How would you classify it?
- 23. **Explain** which type of bird, a duck or an ostrich, would have lighter bones.
- 24. **List** the features of birds that allow them to be fully adapted to life on land.
- 25. **Concept Map** Copy and complete this concept map about birds.



- 26. **Describe** A mammal's teeth are similar in size and include all four types of teeth. What kind of mammal has teeth like this?
- 27. **Classify** You discover three new species of placentals, with the following traits. Using **Table 1** in this chapter, place each placental into the correct order.
 Placental 1 swims and eats meat.
 Placental 2 flies and eats fruit.
 Placental 3 runs on four legs and hunts.

- 28. **Classify** Group the following mammals as herbivore, carnivore, or omnivore: bear, tiger, opossum, raccoon, mouse, rabbit, seal, and ape.
- 29. **Compare and contrast** the teeth of herbivores, carnivores, and omnivores. How are their types of teeth adapted to their diets?

Performance Activities

- 30. **Song with Lyrics** Create a song about bird adaptations for flight by changing the words to a song that you know. Include in your song as many adaptations as possible.

Applying Math

Use the graph below to answer questions 31 and 32.

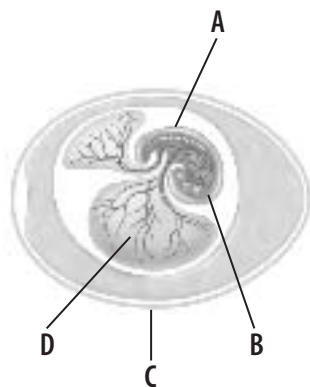
Record of Canada Geese	
Year	Number of Geese
1996	550
1997	600
1998	575
1999	750
2000	825

- 31. **Number of Geese** This table is a record of the approximate number of Canada geese that wintered at a midwestern wetland area over a five-year time period. Construct a line graph from these data.
- 32. **Population Increase** What percent increase occurred in the Canada goose population between 1996 and 2000? What percent increase occurred each year?

Part 1 Multiple Choice

Record your answers on the answer sheet provided by your teacher or on a sheet of paper.

Use the illustration below to answer questions 1–2.



- Which letter represents amniotic fluid?
 - A
 - B
 - C
 - D
- Which letter represents a developing embryo?
 - A
 - B
 - C
 - D
- Which of the following features is an adaptation that allows birds to fly?
 - a gizzard
 - bones that are almost hollow
 - a crop
 - a four-chambered heart
- Which of the following is a monotreme?
 - a penguin
 - an eagle
 - a kangaroo
 - a platypus
- What is a characteristic that sets mammals apart from birds?
 - They help pollinate flowers.
 - They have a four-chambered heart.
 - They have special glands that produce milk for feeding their young.
 - They have a special skeleton that is light-weight but strong.

Use the illustration below to answer questions 6–7.



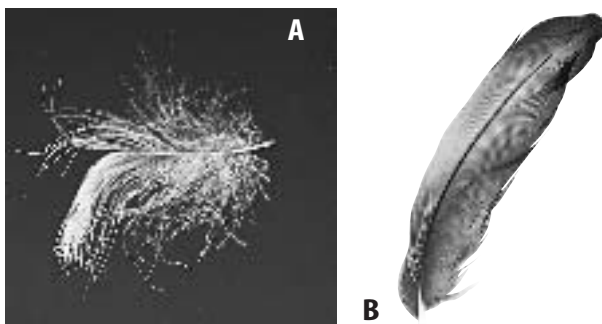
- What part of the mammal's body is indicated by 1–4 in the diagram?
 - small intestine
 - large intestine
 - stomach
 - gizzard
- Which animals have this type of digestive system?
 - carnivorous birds
 - carnivorous mammals
 - herbivorous mammals
 - birds that eat only nuts and seeds
- What is the significance of *Archaeopteryx*?
 - It was the first birdlike fossil found.
 - It represents the direct ancestor of birds.
 - It was probably a ground-living dinosaur with wings.
 - It is the oldest birdlike fossil.
- What is the unique characteristic of a marsupial?
 - They all live in Australia.
 - Their young develop in a pouch.
 - They lay eggs.
 - They provide milk for their young.

Part 2 Short Response/Grid In

Record your answers on the answer sheet provided by your teacher or on a sheet of paper.

- What are two examples of body features that enable birds to fly?
- What does it mean if an animal is an endotherm?

Use the photos below to answer questions 12 and 13.



- What is the purpose of feather B?
- What is the purpose of feather A?
- In a bird's digestive system, what purpose do the crop and gizzard serve?
- What adaptation in birds provides a constant supply of oxygen for the flight muscles?
- Give two examples of special structures produced by the skin of mammals.
- Give the names of the three groups of mammals based on how their young develop. Give an example of each one.

Test-Taking Tip

Essay Organization For essay questions, spend a few minutes listing and organizing the main points that you plan to discuss. Make sure to do all of this work on your scratch paper, not on the answer sheet.

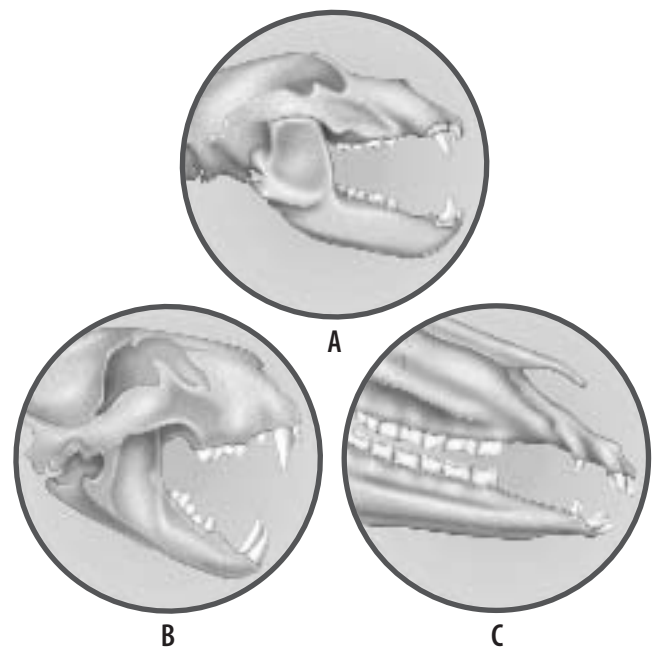
Question 18 List the characteristics that you want to discuss in one column, and the advantage in flight in another column.

Part 3 Open Ended

Record your answers on a sheet of paper.

- Describe the physical characteristics of birds' bones that make flight possible.
- Compare the barbs of a contour feather with those of a down feather.
- Describe the function of wings in flightless birds such as penguins and ostriches.
- Explain how feathers help a bird fly.

Use the illustration below to answer questions 22 and 23.



- How can you tell that diagram C does NOT represent a carnivore? What can you tell about the diet of the animal that would have the type of teeth shown in diagram C?
- What can you say about the diets of the animals represented by the teeth shown in diagrams A and B?