



# Mammals:

## A Resource for Teachers

*Copyright: Dallas World Aquarium, 2023*



Mammals can be found walking, running, climbing, swimming, flying, or burrowing on all continents. Most mammals are terrestrial or arboreal, however, seals, whales, dolphins, porpoises, dugongs, and manatees are aquatic. Mammals breathe air, even those that live in water. The frequency of breathing differs, with larger mammals breathing at longer intervals than smaller ones. Mammals vary in size from the tiny shrew to the gigantic blue whale.

Three characteristics, not found in other animals, are shared by all mammals:

1. The inner ear contains a chain of three bones: the malleus, incus, and stapes. These bones allow mammals to hear sounds transmitted to the inner ear.
2. Hair, which is made up primarily of a protein called keratin, is present at least for some time during the life of all mammals. It is found in varying amounts, locations, textures and may serve:
  - as insulation and protection
  - as sensors (whiskers or “vibrissae” that allow animals to sense contact with external stimuli)
  - to camouflage, announce the presence of an animal, communicate social information, denote gender, or signal danger (color or pattern of hair)

All female mammals have mammary glands that secrete milk. Mammary glands are found in both sexes but do not develop in males. Female mammals feed newborns with milk produced by these glands, which vary in number from two (as in humans) up to twenty.

Besides the three unique characteristics, most of these warm-blooded mammals also have:

- a muscular diaphragm that separates the heart and lungs from the abdominal cavity
- a four-chambered heart
- differentiated teeth
- a highly-developed brain
- internal fertilization
- live birth (except monotremes that lay eggs instead of giving birth to live young)
- separate sexes, with sex of offspring being determined by chromosomes

Based on eating habits, mammals are carnivores, herbivores, or omnivores. Carnivores eat live or dead animals, herbivores feed on plants (grasses, roots, leaves, and fruits), and omnivores feed on both animals and plants.

There are more than 5,000 living species of mammals that are often placed in just under 30 scientific orders. Mammals are divided into three subclasses – monotremes, marsupials and placentals.

- Monotremes, like birds, lay eggs but feed their young with milk secreted through pores over an area on the chest that is without nipples. Included in this subclass are the duck-billed platypus and two species of echidnas (spiny anteaters). They are found only in Australia and New Guinea.
- Marsupials (mammals with pouches) give birth to underdeveloped and helpless (altricial) young. These young remain in the pouch until they are old enough to live independently. Some marsupials are kangaroos, opossums, koalas, wallabies, and wombats.
- Female placental mammals nourish their young through the placenta (the vascular organ that unites the fetus to the mother's uterus). The largest of the subclasses, there are approximately 4,000 species, including those with which we are most familiar – humans and pets.

The orders, families and species listed below are represented at The Dallas World Aquarium:

Carnivora

Felidae - ocelots

Mustelidae - otters

Chiroptera

Psyllostomidae - bats

Diprotodontia

Macropodidae - kangaroos

Hyracoidea

Procaviidae - hyraxes

Lagomorpha

Leporidae - rabbits

Pilosa

Bradypodidae - three-toed sloths

Megalonychidae - two-toed sloths

Myrmecophagidae - anteaters

Primates

Atelidae - howler monkeys

Callitrichidae - tamarins

Pitheciidae - saki monkeys

Rodentia

Dasyproctidae - agoutis

Sirenia

Trichechidae - manatees

# CARNIVORA

The word “Carnivora” (one order of placental mammals) means “meat-eaters.” Even though the order Carnivora consists mainly of meat-eating animals, not all members of this order are exclusive carnivores and not all meat-eaters are in this order. For example, the giant panda mostly eats bamboo, coatis and kinkajous eat fresh fruit, and bears, skunks, jackals, and raccoons are omnivorous.



Most Carnivores have:

- a carnassial pair of teeth (canines) to aid in eating meat
- powerful jaws that only move up and down
- acute senses
- speed
- a simple digestive system (they do not have to break down cellulose from plants)
- large brains
- a medium-size body
- found in all oceans and continents

Carnivores that live in and around marine habitats are classified in the suborder Pinnipedia, which is made up of five families including seals, sea lions, walruses, sea otters, and polar bears. Carnivores which live on land are classified in the suborder Fissipedia.

Some carnivores, such as the lion, wolf, and cheetah, are excellent hunters. These animals chase and kill their prey. Others, such as the dingo and hyena, often scavenge for carrion. Most carnivores will scavenge if dead animals are available, however, they can hunt their own prey if necessary.

Marine carnivores, known as pinnipeds (“pinni” – fin, “ped” - foot), are rather large animals. Most are insulated with a layer of fat called blubber and have paddle-like limbs. The terrestrial carnivores, known as fissipeds (“fissi” – paw, “ped” foot), are often divided into two main groups, caniform (dogs) and feliform (cats).

## FELIDAE



Most small cats fall in the genus *Felis* of the Felidae subfamily, and big cats often fall in the genus *Panthera* of the subfamily Pantherinae.

Cats (Felidae) are exclusively carnivores. They are probably the most specialized hunters of all mammals. Felines characteristically have small skulls and short faces. Their ears easily rotate to pick up sounds or as body language to communicate their intentions. Strong jaws and modified molars are specialized for killing and meat-eating. The tongue has back-slanted projections (papillae) that help clean meat from the bones.

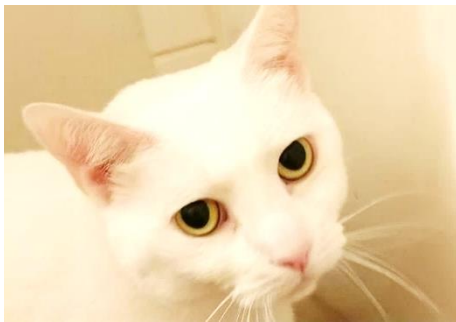
All cats walk on their toes with the back of the foot raised (digitigrade). The well-padded feet have five toes on the front and four toes on the hind feet. The first toe on the front foot (dew claw) is on the side of the leg. This toe has disappeared on the back foot. Dew claws, because they do not wear down and thus always sharp, are important in downing their prey at initial contact.

Except for the cheetah, all cats have long, sharp retractile claws. This protects the claws from excessive wear, keeps them sharp for climbing and allows the cat to draw the claws in so the paw can be used without scrapping or tearing. Because of their curved claws, cats (except margays) are required to back down the trees they have climbed. Margays can climb down a tree vertically and upside down. Cats, often seen sharpening their claws, depend on their claws for grabbing prey. Damaged claws usually regenerate.



Most cats have exquisite and agile bodies with a flexible skeletal structure that enables them to land on their feet when jumping or falling. They are covered in soft fur. Feline coats are adapted for various climates, with long, dense fur found on cats in cold regions. An important function of the coat is to provide camouflage. Their disruptive coloration (spots, stripes, blotches set in a lighter background) breaks up the body outline. The variations of patterns on different species of cats allow for effective camouflage in their respective habitats. Males are usually longer and heavier than females but have about the same shape and color.

Cats prey on anything they are large enough to kill, including mammals, reptiles, birds, fish, and even large insects. Felines capture their prey by stalking it or by patiently waiting in ambush (followed by a swift pounce). Sprinting chases by the cheetah have been recorded at more than 65 mph (105 kph). The combination of teeth, claws, strong jaws, and powerful shoulders allows the cat to grab, drag down, and kill prey with a powerful bite to the head or neck.



Cats heavily rely on their senses of sight and hearing. The pupils of the eyes contract to vertical slits during the day and expand in the dark. They have binocular vision and the ability to perceive color. Smell is usually used for examining the kill. Long whiskers provide an acute sense of touch at close range. The mystacial whiskers on the sides of the face are the most important and well-developed. It is believed these whiskers help the cats find their way in the dark and give information about where to bite their prey to inflict the fatal blow. The superciliary whiskers, located above the eyes, probably serve a protective function. Genial whiskers are those back on the sides of the face, somewhat in line with the mystacials. Carpel hairs at the back of the forelegs are also responsive to touch.

The gestation period in felines varies from 56 to 114 days, with smaller cats requiring fewer days. Female cats seek out an appropriate den where they give birth to between one and seven offspring. Litter size is not directly related to the size of the species. Offspring are usually called kittens in the smaller species and cubs in the larger ones. Cats are born in a semi-altricial state. Their eyes are closed at birth and normally open between one and two weeks of age. The eyes of the larger species of cats open earlier and lion cubs can sometimes see from birth. Except for the lion, the mother cat is solely responsible for the care and feeding of her young. Mothers must also teach the cubs to recognize and kill prey.

Cubs stay near their mother until they are approximately six weeks old, which is when they leave the den. Cubs rely on their mother for food until they lose their baby teeth and adult teeth appear, which is necessary for a young cat to catch their own prey. Cubs keep in contact with the mother for up to two years.

Communication by vocalization is quite different between the large and small cats. Based on anatomical differences of the throat, larger cats are said to “roar” and smaller ones “purr.” Cats that purr can do so continuously while breathing both in and out. Vocalizations are used to communicate with other nearby cats. Hissing and spitting are evident when cats are antagonized, usually followed by body language.



Other visual communication includes ear movements, an arched back, a crouching stance, and tail movements from side to side. A “slinking” movement and flattened ears may show submission. Cats are quite territorial and mark their spaces with glandular secretions and/or urine. Scent glands, scattered over various parts of the body, are used to communicate territory and mating stages. Larger cats often mark their space by depositing feces in strategic places. If not needed for communication purposes, larger cats, like most smaller ones, may choose to bury their feces. Scratch marks on logs are commonly left for others to see. Some carnivores (skunks) have scent glands for defense purposes. Although most carnivores are considered solitary animals, they socialize through communication based on sight, sound, and scent. Some live in groups that may be dominated by males or by females. The social organization of lion groups (prides) be related to finding food.

## OCELOTS



Ocelots are known for their beautiful coats. They have short fur that is marked with both black spots and rosettes. The base color ranges from tawny to reddish brown. Their undersides tend to be lighter or white in color. They have a single, white spot on the back of each ear and some white markings around their eyes and mouth. Two black lines run the length of either side of their face and the tail is marked with black bands. Ocelots have large red-brown eyes. They have retractable claws, like most cats, so the claws remain sharp for seizing and holding prey.

Ocelots are the largest of the small spotted cats. Length is from 36 to 40 inches (80-100 cm), tail 12 to 20 inches (30-50 cm), height to 18 inches (46 cm) at the shoulder, weight 25-35 pounds (11.3-15.9 kg).

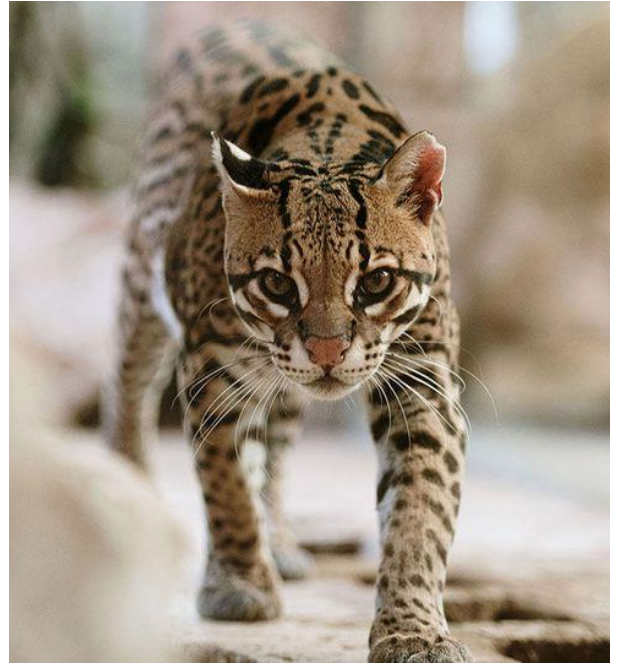
Ocelots are opportunistic feeders, taking almost any animal it can overpower, remaining in dense cover when possible. They are strong swimmers, although they do not enter the water readily. Although they seem to prefer ground hunting, they are excellent climbers and occasionally stalk monkeys, iguanas, lizards, and birds in trees. Largely nocturnal, their spotted coat makes them quite inconspicuous. They usually sleep during the day in trees or hidden under cover. They move quickly and quietly in the undergrowth catching mice, rats, rabbits, pacas, agoutis, peccaries, opossums, frogs, crabs, and small turtles.

These cats have a fixed territory, which they mark with excrement and scent. Their large eyes allow for acute binocular vision and good night vision, adapted for hunting. Hearing is also excellent, even though the ears are

relatively short; sense of smell is also quite good. The whiskers are extremely sensitive to touch. Although they may often hunt with another Ocelot, they are considered solitary, except during mating and giving birth, sometimes “mewing” to keep in touch with each other.

Gestation varies between 79-85 days. Litter sizes are small, usually only one or two young, with the rare occurrence of three. Only the females care for the young, although males help by bringing food for the mother. Females prepare dens for their kittens in thick brush. Mothers leave at night to hunt but spend all day with their kittens in the den. The kittens begin hunting with their mother when they are about three months old and are independent after approximately one year (but may stay with the mother for an additional year). The kittens are darker at birth but otherwise colored like their parents. They are blind at birth but well-furred.

Ocelots live in a variety of habitats, including mangrove forests, coastal marshes, savannah grasslands, pastures, thorn scrub and tropical forests. All these habitats provide dense vegetative cover. They are found in the southwestern U.S. (Arizona and Texas), throughout Mexico and Central America and in South America from northern Argentina and Paraguay to Ecuador but are absent from Chile.



## MUSTELIDAE



Animals that belong to the family Mustelidae are called mustelids. Mustelids are native to all continents except Australia and Antarctica. They are the largest family of carnivores, with about 26 genera and 67 species. Mustelids include weasels, stoats, ferrets, fishers, tayras, wolverines, grisons, martens, otters, badgers, skunks (debatable) and others. With their differing lifestyles, the mustelids have adapted to almost every type of terrestrial habitat (underground to treetops) and to aquatic environments (both fresh and salt water).

Most mustelids (except for the wolverine and badger) are extremely slender and long, with rather dished-in faces. They spend most of their time hunting for food to sustain their high metabolic rates. They range in size from the cigar-sized Least weasel, smallest of all carnivores at eight to ten inches (20 - 25 cm) in length and weighing 1 - 2.5 ounces (28 - 71 gr), to the Giant otter, five to seven feet (1.5 - 2 m) in length and weighing up to 65 - 100 pounds (29 - 45 kg).

Known for their fidgety energy, mustelids are sometimes considered “fearless.” Their motions are quick, though not always graceful, requiring extreme endurance and strength. Their short legs are powerful, and their five-toed feet are adapted for running, climbing, digging or swimming. Otters are master swimmers and can stay submerged for three or four minutes.

When viewing otters are at the surface, three “humps” appear, each separated by five to eight inches (13 - 20 cm) of water. The “humps” are the otter’s head, back, and the end of the tail that is curved above the water line. Maneuverability is the best swimming skill of the otter. They can make quick turns by using the tail and back legs like a rudder. Otters can also swim in tight circles, dragging small fish up that have hidden under an overhanging bank.

When surfacing, the otter stretches its neck and turns its reptilian-like head from side to side before surfacing or coming out on land. They can travel as much as 16 miles (26 km) on land in a single night. On land, they move awkwardly by arching their back, often taking a couple of bounds, and sliding on their belly for several feet. On slippery slopes, otters may slide on their bellies for some distance.

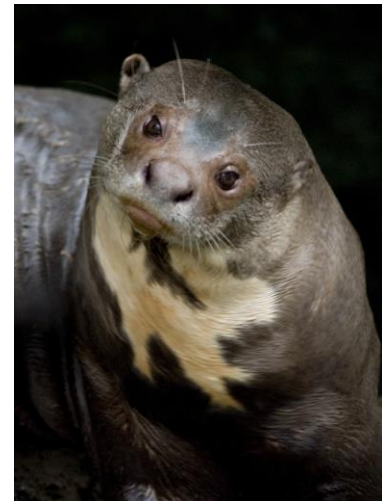
All mustelids are either plantigrade (place the full length of the foot on the ground during each stride) or digitigrade (walk on their digits and not the soles of their feet). Each foot has five toes. The tail is usually long, the small ears are rounded, and the eyes are usually small. All mustelids have well-developed anal glands for marking territory or using as potent weapons (like the skunk). The coats of the sea otter, sable, mink, marten, and ermine are soft and dense. Historically, these animals have been exploited because of the demand for luxurious and warm garments.

The 13 species of otters are the most aquatic of the Mustelids. They are found on five continents, in freshwater streams, rivers, lakes, and coastal areas. They prefer bodies of water that are free of weeds and undisturbed by humans. Otters are usually at the top of their food chains, but when young, they fall prey to jaguars, wolverines, killer whales, and other predators. The main threats to their survival are disease and man-made problems, such as the fur trade, poaching, pollution, pesticides, dams, habitat destruction and fishing nets.

## GIANT OTTERS

The giant otter (*Pteronura brasiliensis*) is the largest otter in the world. It is sometimes called the Guiana flat-tailed otter, winger-tailed otter, margin-tailed otter, and river wolf (“lobo del Rio”) in Spanish. It lives in freshwater rivers, creeks, and lakes from Venezuela to Argentina. Each otter can be recognized by a unique pattern of creamy white spots on the lips, chin, chest, and neck.

During the rainy season, giant otters will follow fish as they move into the flooded forest. During the dry season (when cubs are reared), they become less mobile. Averaging six feet (1.8 m) in length for adult species, they have been recorded at almost eight feet (2.4 m) from head to tip of the tail. They are valued for their dense brown, velvety fur.



These aquatic predators are well-adapted to swimming. Their powerful tails are muscular, wide at the base and semi flattened at the end – allowing them to move with extraordinary speed in water. The Giant otter moves through the water using different parts of the body, according to its swimming speed. Giant otters use all four feet to paddle and keep the tail stationary when swimming slowly. If moving quickly, the otter propels itself by undulating the tail while keeping the feet stationary. They also have webbing between their toes.

Otters have two layers of hair, one of which is waterproof. Like beavers and muskrats, long coarse guard hairs cover and protect the short thick underfur which traps air and keeps the skin dry. Their heads are round and

supported by very developed muscles and jaws that allow them to swallow large whole. Special muscles enable the otter to close its nostrils and ears when underwater. The nose is completely covered in fur, with only the two slit-like nostrils visible. Their eyes are large and acute, great for hunting underwater.

Giant otters are piscivores, feeding mainly on fish which they hunt during the day. Two species of fish make up more than seventy percent of their diet – characins and cichlids. Unlike most other otter species, they hunt in groups with each animal hunting its own prey to eat on its own. When fish are unavailable, they eat crustaceans, snakes, and caimans.

They rely mostly on vision but also use sound and touch when hunting for food in murky water. They eat an average of six to nine pounds (2.7 - 4.1 kg) of seafood per day. If a prey item is large, it is taken to land to eat. If it is small, it can be eaten as the otter floats on its back. Using its “wolf-like” teeth, whiskers sensitive to water currents, and strong webbed hands, the otter is an extremely effective water hunter. It eats all parts of its prey, including the bones.



Giant otters usually live in family groups of up to ten members. Groups are territorial and consist of a monogamous pair and their offspring from several years. Older siblings assist in taking care of the young when the parents are busy. They mark their territories with scent from the anal gland. Although territories are maintained, they are very social animals.

Most of their time is spent in the water, though they sleep as a family in a den at night. Living areas are prepared by trampling the surface vegetation, collecting tree limbs and leaves, and embedding the leaves and branches into the trampled mud patch. Large, long burrows are then constructed under fallen logs on the banks of rivers and lakes. One to five communal latrines are also created along the perimeter of the site. Parents defend the marked territory (and their offspring) if intruders invade their space. They also groom each other.

They communicate vocally with many different sounds. These vocalizations probably serve as warning signals against predators and as contact calls. Giant otters constantly interact through high-pitched hums, whining squeals, and screeches. When frightened, they surface out of the water, crane their necks, and snort loudly. In the wild, otters can often be heard before they are seen.

It is believed that peak breeding season begins in late spring/early summer, with some breeding taking place throughout the year. Mating occurs in the water, and the gestation period is between 65 - 72 days. Up to four altricial cubs are born between late August through early October. Each offspring weighs approximately six to eight ounces (170 - 227 gr). High juvenile mortality rates often lead to conception of a second litter, usually between December and April.

The young stay in the den for up to two months before venturing out and participating in group hunts. They remain dependent on their mother's milk until they are approximately five months old. They are independent hunters and indistinguishable from their parents at 9 to 10 months. After reaching sexual maturity at around two to three years of age, young otters leave the group and search for a vacant territory or a mate. The average life span of the Giant otter is 10 - 13 years, though some animals in human care have lived to be 20 years old or more.



*Pteronura brasiliensis* has few predators, but occasionally it is occasionally preyed upon by jaguars and pumas. Vulnerable juveniles left unattended suffer greater predation than adults. Their biggest threat is habitat destruction and water pollution by humans.

## CHIROPTERA

The Order Chiroptera (“chiro” – hand, “ptera” – wing) is made up of flying mammals known as bats. Their long forearms and hands are webbed, allowing them to fly. They are the only group of mammals capable of true flight. They use echolocation for navigating and locating prey. In mammals, only rodents contain more species than bats.



### Phyllostomidae

This Family of New World bats includes approximately 150 species. They are often referred to as leaf-nosed bats. They live in many different habitats ranging from the U.S. to Argentina. Most species have a simple “nose leaf” on the muzzle. Leaf-nosed bat fur colors include gray, brown, orange, red, yellow, and white. Leaf-nosed bats range between 1.6–5.3 inches (4.0–13.5 cm) long. They usually live in small groups, however, some species form colonies of several hundred. They roost in caves, tree hollows, buildings, structures constructed of leaves, the undersides of large palm leaves, and under bridges. Their diet varies greatly. Some species are carnivorous, while others feed on blood, fruit, nectar, and or pollen.

### SEBA’S SHORT-TAILED BAT

The dense fur of Seba’s short-tailed bat (*Carollia perspicillata*) is usually dark brown to dark gray in older animals. Some are rusty orange in color, though this is rare.

Seba’s short-tailed bats are gregarious and live in groups of up to 100 in caves, hollow trees, tunnels, and road culverts. Peak activity occurs shortly after sunset.

This species can be destructive to crops and are sometimes seen as pests. Short-tailed bats enter a state of torpor (a time when the heartbeat, temperature, and other body activities slow) when food is lacking. There are two roost types: harem (adult male with many females and their infants) and bachelor (adult and juvenile males without a harem).

Vocalizations between the males and females warn intruding males and control the females. Harem males also guard the infants while their mothers are out foraging and help to reunite the two.

The adult length is 1.8 - 2.5 inches (4.6 - 6.4 cm). Adults weigh between 0.6 - 0.7 ounces (16 - 20 gr). Adult wingspan is about 8 - 9 inches (20–23 cm). Because of their relatively small size, they eat small fruits containing small seeds. They favor the seeds from the black pepper family (Genus *Piper*) but also eat other plants, fruit, pollen, and insects. Their ability to switch food sources may be why they are so plentiful in the wild.



Generally foraging close to the ground, Seba's short-tailed bats feed at several sites during a single night. They have an excellent sense of smell and use echolocation to navigate at night. These bats make a variety of sounds, both audible and ultrasonic. The audible sounds are used to communicate between mothers and their young, between roost mates, to attract mates, and as alarm cries.

Seba's short-tailed bats have two reproductive periods. The larger one coincides with peak fruit season, (June-August) and the other with the blooming of flowers at the end of the dry season (February-May). Gestation is 113- 120 days, and a single infant is usually produced. Newborns weigh approximately 0.176 ounces (5 gr). Sexual maturity may be as early as nine months to one year of age for females and one to two years for males.

Found in moist evergreen and dry deciduous forests from northern Argentina to southern Mexico. Seba's short-tailed bat is probably the most abundant mammal living in the New World tropics.

## COMMON VAMPIRE BAT



Most Common vampire bats have a small, circular, compact, and muscular body that is varying shades of gray above and lighter gray underneath. Their short, fine fur varies in length, giving them a rather disheveled look. The common vampire bat is the most agile of all bats. It can fly, climb vertical walls, run, jump, hop, and fling itself upward for flight (which is necessary for stalking and attacking prey).

Vampire bats have fang-like incisors and a long, pointed pink tongue. Two projecting, large, sharp upper incisors are joined at the bases by impressive canine teeth. Only the canine teeth are pointed and sharp on the lower jaw. The small peg-like front teeth used to grasp their prey are widely spaced so the tongue can lap the blood. The vampire bat has fewer teeth than other bats.

The short neck and stubby nose give the common vampire bat's face a "bulldog" appearance. The tail is absent with only a narrow membrane connecting the vampire's long hind legs to the rump. The rather large dark eyes are set low on the face. The ears are pointed with a triangular-shaped flap that may assist in echolocation. A deep fold in the jutting lower lip gives the appearance that the lip is split. The long thumb on the edge of the forelimb is longer than the entire hind foot. With its three sole-like pads, it serves as a front foot, allowing the vampire bat to run silently on all fours.

During the day, the nocturnal vampire bat sleeps in places with total darkness, such as crevices or caves, where it hangs upside down. It spends 80% of its time sleeping or resting. They spend two hours each day grooming each other and feeding regurgitated blood to their roost mates (when unable to find their own food). The sharing of food usually occurs between females and young bats. Vampire bats generally live in colonies of 20-100 individuals.

The length of the common vampire bat is 2.8 - 3.5 inches (7 - 9 cm). The wingspan is 7-8 inches (18 - 20 cm), and the average weight is 1.8 -2 ounces (51 -57 gr). It feeds exclusively on the blood of other vertebrates. The teeth slice into the flesh, making a 0.12-inch (0.3 cm) incision that is evidently rather painless, as the sleeping victim seldom awakens. It injects saliva that contains an anticoagulant chemical.

Opening the wound and eating usually takes about 20 minutes. Two channels, located on the underside of the tongue, draw blood from the prey (like drinking through a straw). As the blood begins to flow, the bat sips and licks the blood, normally approximately 2/3 of an ounce (18.8 gr). Common vampire bats eat so much that they are unable to fly until some of the blood has been digested. However, since only red blood cells are needed, the digestive system quickly converts the plasma to urine, eliminating extra weight while eating.

Even though vampire bats are nocturnal, they have good vision and a well-developed sense of smell which helps detect prey and recognize roost mates. The heat-sensing pits around the nose help the bat select warm body parts with a rich blood supply close to the surface of the skin. A good sense of touch warns the bat if prey is awakening from sleep.

Hearing is the most important and accurate sense of the vampire bat. Vampire bats, like most bats, navigate by echolocation. This involves producing and projecting high frequency sounds that reflect off objects. Bats listen to the reflected sound (or “echo”) to gain information about their surroundings and the location of their prey. The sounds used in echolocation are too high to be audible by humans. Vampire bats use sounds of a lower frequency for social interactions.

Common vampire bats are sexually mature at approximately nine months of age. Most females normally have one pregnancy each year. The gestation period is around seven months, usually resulting in a single offspring (with the occasional set of twins). The well-developed newborn weighs between 0.18 - 0.25 ounce (5 - 7 gr) at birth. After one month of feeding on milk from the mother, the mother regurgitates blood for the infant until about four months of age, at which time it begins to hunt with its mother. Growth is normally complete at about five months of age.

Vampire bats are the only mammals that feed entirely on blood. Their saliva contains an anti-coagulant which keeps the blood vessels from contracting. Known as Draculin, the anti-coagulant keeps the wound bleeding freely for up to 30 minutes. The anticoagulant in vampire bats is twenty times stronger than any other known clotting agent. A normal wound the size of a vampire bat bite, would usually cease bleeding in 1-2 minutes. Studies are being conducted to determine how this anticoagulant might help with serious human disorders like heart attacks and strokes. It is also believed the saliva may contain a numbing anesthetic to deaden the pain, thus keeping the host from being aware of the bite.



Because of their feeding habits, vampire bats are potential transmitters of a variety of diseases, the most notable being rabies. Any mammal, including man, can become infected by the bite of a rabid vampire bat. The usual victims are cattle and other vampire bats. The virus-containing saliva is passed onto other vampire bats when grooming, sharing regurgitated food, or socializing. Sudden decline of the vampire bat's regular prey can cause attacks on humans. Bites on humans are usually on the toes, noses, and ear tips, however, incidents of humans contracting rabies from vampire bats are rare.

Vampire bats are found in mines, caves, hollow trees, or rock crevices throughout Mexico, Central America, northern Argentina, and Chile.

## DIPROTODONTIA



This large Order is made up of 117-120 marsupial mammals in 10-11 families, including but not limited to kangaroos, wallabies, possums, koalas, and wombats.

Diprotodont is Greek, meaning "two front teeth". All exhibit a large pair of incisors on the lower jaw. Most diprotodonts have three pairs of incisors in the upper jaw, and some have a second pair of small incisors in the bottom jaw. They lack canine teeth and have empty spaces where these teeth would normally be. This dental pattern is due to their diet. Being herbivores, the sharp front teeth cut up pieces of grass and leaves for eating. Canines are usually used for tearing meat and are not necessary for plant-eaters.

Diprotodonts can be distinguished by the following characteristics:

- Syndactylous hind limbs. The second and third digits of the feet are completely fused together, except for the claw.
- Unique reproduction. After a short gestation period (typically between 28 and 35 days), the developing offspring will crawl to the pouch and attach to the mother's teat where it will remain for several months.

Diprotodonts are native to Australia, New Zealand, New Guinea, and surrounding islands. They can be found in a variety of terrestrial habitats from grasslands to forests and mountains where it snows most of the year.

### Macropodidae

The family Macropodidae, which includes marsupials such as kangaroos, wallabies, tree-kangaroos, pademelons, and others. Macropod is Greek, meaning "large foot". They are herbivores and as mentioned in the characteristics of the Order Diprotodontia, they have specialized teeth for eating fibrous plants. Their digestive system is specialized to digest plant material. There is much variation in size in this family, but the majority have large hind legs and a powerful, long tail, with exceptions to this characteristic being found in the genus *Dendrolagus* (tree kangaroos). Tree kangaroos have shorter and broader hind feet and a shorter tail and are excellent climbers.

## MATSCHIE'S TREE KANGAROO

Matschie's tree kangaroos are named after Paul Matschie, a German zoologist. They are chestnut to red brown in color, with bright yellow bellies, ear edges, and feet. The eyes are large, and the ears are small. Their faces are yellow and white, and a dark stripe runs down the back.



Their forearms are long and strong, though unlike primates, they lack opposable thumbs. However, they have dexterous forepaws and flexible wrists, and can grasp stems in their fingers. Their back legs and feet are short and broad with rough-textured pads and long, curved claws to improve their grip.

They do not have the much larger hind legs like other kangaroos. They descend from trees tail-first. Tree kangaroos have a way of staying dry that kangaroos in arid regions lack. The fur on their neck and back grows in a reverse angle from the rest of their coat. During a rain shower, they crouch with their heads lower than their shoulders. The backward-growing hair on the neck and back allows water to flow off and keeps the kangaroo dry.

Dendrolagus is Greek for "tree hare." Long hind limbs typical of leaping kangaroos have been modified in tree kangaroos and are slightly shorter than their powerful forelegs. This gives tree kangaroos greater control and balance for climbing and moving through trees. They are extremely agile in trees but not on the ground. If trapped in a tree, they will attempt to escape by leaping to the next tree. Unlike other kangaroos, tree kangaroos can move their hind legs independently of one another. Consisting of ten species, this is the only genus of the kangaroo family that climbs trees.

It is believed that Matschie's tree kangaroos are solitary animals. Females have non-overlapping home ranges but a male's range will overlap the range of several females. Researchers also believe that Matschie's tree kangaroos are polygamous and that males will interact with several females. Males, however, appear not to establish "harems," and females remain independent. The only strong social bond these animals form is between mother and offspring. They sleep 60% of the day.

Females weigh approximately 17 pounds (8 kg) and are slightly larger than males, which average about 15 pounds (7 kg). The body is between 20-32 inches (52-81 cm) long. The tail length is 17-36 inches (43-91 cm). Tree kangaroos are browsers and 75-80% of their diet is leaves, buds, and fruits. In captivity, they will eat bird eggs and young birds. They have well-developed senses of vision, touch, smell, and hearing and use visual displays, touch, vocalizations, and chemical cues.



The female gives birth to one offspring (called a joey) after a gestation period of 42-44 days, the longest of any marsupial. After birth, the fetus-like young (about one inch / 2.5 cm) crawls to a teat located inside the mother's pouch where it attaches itself to nurse. Most of the infant's development occurs during the lactation phase. It remains in the pouch for about 8-10 months. The mother will frequently clean her pouch and groom the infant during this phase.

After around 28 weeks, the infant starts to leave the pouch, though it will continue to return to the pouch to nurse. This "in and out" phase lasts for one or two months. During the final phase, the young still nurses but never climbs completely into the pouch. The infant is weaned approximately one year after birth. They will then go off alone and establish a home range.

Matschie's tree kangaroos can be found in mountainous rainforests at elevations of up to 6,562 feet (2,000 m). They are found on the Huon Peninsula of northeastern New Guinea. They are hunted for their meat and their habitat is being destroyed for logging, mining, agriculture, and oil exploration.

## HYRACOIDEA

Hyracoidea is an order of small, hoofed mammals, made up of a single living genus, the surviving hyrax, whose nearest living relatives are elephants and sirenians (dugongs and manatees).

Hyrax is a Greek word meaning "shrewmouse". Some hyraxes live in trees and some live in colonies with up to 50 members. They resemble rabbits or large rodents. Their entire foot, from the toes to their heel, touches the ground (plantigrade). Pads on their feet are kept moist through a gland that secretes a fluid that helps them keep a grip on slippery surfaces.

They have five toes on their front paws and three-toes on their hind feet. The first and third toe on their hind feet have nails while the middle toe has a long claw. Hyraxes are herbivores and live in colonies. Their kidneys allow them to retain a large amount of water, making it easier to live in their hot, dry habitats. Even though they can often be seen making a chewing motion, their multi-chambered stomach allows them to extract nutrients from plant material. Each chamber in the stomach has symbiotic bacteria that allows them to break down plant material and digest fiber.

All living hyraxes are members of the family Procaviidae (the only living family within the order Hyracoidea).

## ROCK HYRAX

Rock hyraxes (*Procavia capensis*) are brownish gray on the top side and creamier in color underneath. They resemble a large guinea pig or a rabbit with rounded ears and no tail. They are predominantly diurnal, social animals that live in small to large groups of up to 50 individuals. Due to poor thermoregulation, hyraxes spend a lot of time in the sun to keep warm. They hide among boulders and in rock crevices. Sweat glands and muscles make the rubber-like bottoms of their feet function like suction cups, helping them climb and grip rock surfaces. The toes are stumpy with hoof-like nails (four toes on the front feet and three toes on the back feet).



The body of the Rock hyrax ranges from 12-21 inches (31-53 cm) in length and the average weight is 8-9 pounds (3.6-4 kg). Rock hyraxes are primarily vegetarians but sometimes eat insects and grubs. They have excellent eyesight. The shape of their eyes is unique as the iris extends out above the pupil. This allows the hyrax to look more directly into the sun to watch for birds of prey by cutting off light that shines directly above its head. Adults have more than 20 vocalizations that allow communication with their young and other group members. An alarm call signals when danger is approaching.

Hyraxes reach sexual maturity at 16-17 months of age. After a gestation period of 205-245 days, females give birth in a protected rocky crevice to an average of one to three young. At birth, the eyes are open, and the infants are covered with hair.

Rock hyraxes live in rocky, scrub-covered habitats with plentiful sheltered areas. They are prevalent in Africa but are also found in Egypt, Syria, Lebanon, Israel, Jordan, and Libya.

## LAGOMORPHA

The Order Lagomorpha is made up of two families: the Leporidae (hares and rabbits) and the Ochotonidae (pikas). There are 13 genera and 80 species in these two families.

The name of the order is from the Greek *lago* ("hare") and *morph* ("form"). They generally have large ears, a short tail, wide-set eyes, and slit-like nostrils that they can close. The two families differ in general appearance. Leporidae are larger, have short bushy tails, long ears, and long hind legs. Ochotonidae are smaller with rounded bodies, tiny tails, short legs, and rounded ears.

All lagomorphs are terrestrial, occupying a wide diversity of habitats from tropical forest to tundra regions. All are herbivores, feeding on grasses and other small plants. Their continuously growing incisors are well suited for eating vegetation. This continuous growth is an adaptation to their rough food and helps maintain a sharp edge on the incisors. Lagomorphs have two upper incisors on each side. The second incisor is a small peg behind the larger incisor in front. Lagomorphs can produce two types of fecal material. One type is wet and can be eaten again for further nutrient absorption. The other is dry and discarded. Lagomorphs have a very large digestive system that allows them to digest the plant matter. The digestive system has microorganisms that help break down plant material and produce proteins and vitamins.

Native populations are found on all continents except Australia and Antarctica; however, humans have introduced them many areas where they were originally not native. Lagomorphs tend to be highly reproductive, especially among the leporids.

## Leporidae

The family Leporidae is made up of rabbits and hares. There are 11 genera divided into approximately 54 species. Females are usually larger than males. Leporids range in weight from 1.4 pounds (0.6 kg) to 11 pounds (5 kg). Adult body length ranges from 9-28 inches (23-71 cm). Color patterns vary between seasons and species, ranging from black to chestnut to white. Leporids are widely distributed and have adapted to a broad range of habitat types. They can be found throughout the world with very few exceptions. Habitat type affects fur color as well as litter size. Some leporids are extremely social, living in large communal dens, while others are solitary, coming together in groups or pairs for mating purposes only.

Rabbits give birth to altricial infants that are born with no hair and closed eyes. The infants spend time in a fur-lined nest hidden in dense vegetation. They are not as fast as hares. Hares give birth to precocial young that are born with hair, open eyes and ready to run. They do not make nests (depressions in open areas) have and longer gestation periods than rabbits. They are found in open habitats and can run up to 40 mph.

Both rabbits and hares produce relatively large litters and are prodigious reproducers. Most leporid species are polygynandrous (two or more sexual partners).

## DESERT COTTONTAIL

The Desert cottontail has a rounded tail with white fur on the underside. It is a light gray/brown in color, with creamy colored fur on the belly. It has long ears and large hind feet. They are like rodents in that their teeth grow throughout their life, necessitating constant chewing to keep them from growing too long. They are usually seen in the early morning or late afternoon and are rather inactive in the middle of the day, preferring to spend the hottest part of the day under cover. Desert cottontails dig a shallow pit under a bush in which to rest, but they usually rest in the burrows of other animals. They are good swimmers and can run at speeds of up to 20 mph (32 kph).

Desert cottontails eat mostly grasses, but also eat cacti, bark, twigs, and shrubs. Adults are 12-17 inches (30 - 43 cm) long and weigh up to 3.3 pounds (1.5 kg).

Females are larger than males. Desert cottontails have good eyesight and good hearing. They may stomp the ground with their hind feet or raise their short tail as a warning to others of possible danger.

Females usually have two to four litters a year, though some may have as many as six each year. The gestation period is 26-30 days. One to six babies are born in each litter. They are born without fur, and their eyes are closed. They leave the nest at two weeks of age and usually stay with their mother for three more weeks. Sexual maturity is reached at approximately three months of age.

Their range is from southern California into the central United States, from eastern Montana to western Texas and into northern Mexico. They can be found in woodlands, grasslands, brush, and desert areas.





## PILOSA

The order Pilosa (meaning “hairy” in Latin) is a group of placental mammals that includes but is not limited to anteaters and sloths. Though anteaters and sloths are vastly different externally, they have some common skeletal characteristics. There are two families of anteaters (the Myrmecophagidae and the Cyclopedidae) and two families of sloths (the Megalonychidae and the Bradypodidae).



It is estimated that the life expectancy of sloths in the wild is 15-20 years, however, sloths in human care have lived for more than 30 years. Bradypus sloths (those with three fingers) are less common in human care than Choloepus sloths (those with two fingers) because of their limited diet.



Sloths are slow, but certainly not lazy. The sloth’s diet, low rate of metabolism, and small amount of muscle mass all contribute to the slow lifestyle of the sloth. They spend most of their time hanging from branches in the middle layers and tops of trees or sitting in the forks of tree limbs. They thermoregulate by moving to areas of the trees with more sun exposure when cold and moving deeper into the tree to cool off when hot. This lifestyle is interrupted by an infrequent trip (around once a week) to the base of their tree to urinate and defecate.

Because of their anatomy, sloths cannot stand or walk like most mammals. On the ground, they move by dragging themselves with their front limbs. Bradypus (or three-fingered) sloths are competent swimmers, though Choloepus (or two-fingered) sloths do not swim.

Big cats and harpy eagles are among the main natural predators of the sloth, though humans are by far their biggest threat. Deforestation has displaced countless animals, including the arboreal sloths.

## Megalonychidae

This family contains two species, the Linne’s two-fingered sloth (*Choloepus didactylis*) and the Hoffmann’s two-fingered sloth (*Choloepus hoffmanni*). The *Choloepus* species are larger, faster, and more aggressive than the *Bradypus* species. Adult *Choloepus* are 21-28 inches (53 - 71 cm) with an average weight of around 12.5 pounds (5.7 kg). *Choloepus* eat mainly leaves, they also consume flowers and some unripe fruits. *Choloepus* are typically silent, though may bleat or hiss when threatened or disturbed.



Choloepus sloths range in color from light blonde to dark brown. The snout of two-toed sloths is rounded and slightly protrudes. Each forelimb has two long fingers (with sharp fingernails, like claws) and each hind limb has three fingers. These are used for movement, foraging, and defense. Choloepus have no incisors but do have molars and large pseudocanines in both the upper and lower jaw. The back surface of the upper pseudocanines meet the front surface of the lower pseudocanines, continually sharpening their edges. Their teeth grow throughout their lives.

The body temperature of Choloepus sloths fluctuates from 75° F to 91° F (23.8° to 32.7° C). This is more variable than most mammals. Like the Bradypus, the Choloepus travels down to the base of the tree to defecate and urinate. Unlike the Bradypus, Choloepus do not dig a hole for their urine or feces.

They are solitary animals that eat, sleep, mate, and give birth while hanging from a branch. They are somewhat more active than the Bradypus.

## HOFFMANN'S TWO-TOED SLOTH



The course, long, wavy hair of the Hoffman's two-fingered sloth (*Choloepus hoffmanni*) ranges in color from blonde to medium brown. The face is often paler than the rest of the body. The coat often has a greenish cast due to algae growth on the hair. Since the Hoffmann's two-fingered sloth usually hangs upside down, the hair grows and hangs down from the body, tapering in a "drip tip" towards the rump. This allows rain to run off.

The mouth is shaped in a gentle smile under a large, protruding nose. The eyes are large and have dark circles around them. The ears are small and hidden under the hair. The front and back limbs are long and almost equal in length. The forelimbs have two hooked claws, the hind limbs have three. Most mammals have only seven neck bones (cervical vertebrae). Choloepus have five and can rotate the head 180°.

The adults are medium-sized animals. They eat leaves, flowers, and some unripe fruits. They have a large, multi-chambered stomach containing bacteria that allows for fermentation and breakdown of cellulose into nutrients. It takes one full month to digest a meal.

Choloepus use their acute sense of smell and touch to forage for food. Females reach sexual maturity at 3.5 years; males are sexually mature between the ages of 4 and 5. Gestation for two-toed sloths is about 11.5 months. They have one offspring at a time (with occasional twins) and can reproduce again in 15 - 16 months. The infant will nurse on its mother's chest for about six weeks. Babies begin eating leaves a few days after birth. Babies stay with their mothers for one full year, during which they learn what leaves are safe to eat, among other valuable skills.



Choloepus are found in tropical forests in Central and South America, from Nicaragua to the Equator in lowland forests as well as in higher altitude rainforests. Habitat is in areas of continuous canopy and correlated with the mother's home range and tree preference.

## Bradypodidae



This family contains four species of three-fingered sloths, including the pygmy, (*Bradypus pygmaeus*), the pale-throated (*Bradypus tridactylus*), the maned (*Bradypus torquatus*) and the brown-throated (*Bradypus variegatus*). *Bradypus* sloths are smaller than *Choloepus*. They are often grey or brown in color, with white or honey-colored hair interspersed. Males have an oily patch on their backs, containing black, white, yellow, and orange colors. Each patch is unique, like a fingerprint. Females lack the patch. *Bradypus* have distinct stout, short tails.

Three-toed sloths, after descending to the ground to urinate and defecate, cling to the tree trunk while they dig a hole and cover it with their stump-like tail and hind limbs. This covering procedure may be an attempt to hide the odor so that predators cannot find them. Another suggestion is that it helps the tree absorb the nutrients from their excrement, thus contributing to the growth of new leaves for food.

Like the two-toed sloth, *Bradypodids* have no incisors or canines, only molars. Members of this family have more cervical vertebrae than most other animals. Three-toed sloths thermoregulate by moving to areas of the tree with exposure to sun when cold and moving further into the trees when warm.

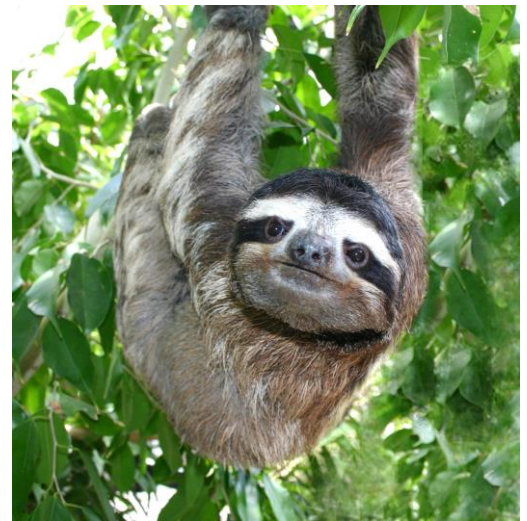
## BROWN-THROATED THREE-TOED SLOTH

The brown-throated three-fingered sloth (*Bradypus variegatus*) is mostly gray and various shades of brown in color. The top of the round head and the area around and to the sides of the eyes are black. The face is almost white. The eyes are small, the black nose is small and short, the teeth are peg-like, and the small ears are hidden under the hair. Males have a large patch of white, yellow, and orange fur with a dark center stripe on their backs. Females lack this patch.

The front limbs of the *Bradypus* are around three times longer than



the hind limbs. They can rotate their heads around 270°. They have three long fingers encased in keratin (fingernails) that look like claws on each of their front and back limbs.

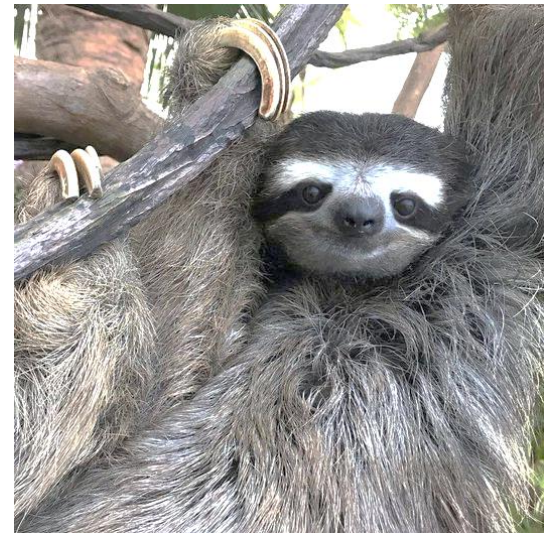


Thick, shaggy fur grows toward the sloth's spine, allowing it to shed water when hanging upside down. Shorter, finer fur grows underneath the outer fur. Green algae grow in microscopic notches and grooves in the hair. It is believed the algae are food for "sloth moths" living in the sloth's hair. The green appearance given by the

algae helps hide the sloth from predators.

Foraging is largely by smell and touch. They are folivores and primarily feed on the leaves and seed pods from *Cecropia* trees, though may eat flowers and leaves from a few other types of trees. They have a large, multi-chambered stomach containing bacteria that allows for fermentation and breakdown of cellulose into nutrients. It takes one full month for a sloth to digest a meal. Adults average 2-2.5 feet (0.61-0.76 m) in length and 8-14 pounds (3.6-6.4 kg) in weight.

Bradypus sloths are typically silent, though when in estrus, the female calls out with a shrill whistle, described as an “a-ee, a-ee” sound when trying to attract a mate.



Sexual maturity is reached at two to three years of age. Gestation lasts around six months. A single infant is born at a time, though twins occasionally occur. Males do not participate in the care of the young. The mother sloth carries the baby on her chest, where it nurses for about six weeks. She also teaches the baby what is safe to eat, along with many other valuable skills. After one full year, the infant can feed itself and live on its own.

*Bradypus variegatus* is found in tropical and subtropical regions of Central and South America. They can be found in many New World tropical forests, living in the canopy where they prefer trees that are highly exposed to sunlight.

## Myrmecophagidae

This family of anteaters is made up of four species, all living in Central and South America. They range in size from 1½ - 4 feet (0.45 -1.2 m) in length and weigh 9 - 90 pounds (4 - 40.8 kg). True anteaters are toothless.

An extremely long tongue makes it easier for an anteater to reach inaccessible places for food. The tongue of the giant anteater can be 20 inches (51 cm) long. The tongue is coated with sticky saliva that aids in catching prey. Anteaters feed almost exclusively on social insects such as ants, termites, and bees. Some anteaters fold their large front claws inward and awkwardly walk on the thick pad on the outside of the limbs.

Some are terrestrial and some have a prehensile tail which is used for foraging arboreally. Smell is their best developed sense. After giving birth to one offspring, the mother carries the baby on her back.



## GIANT ANTEATER



The giant anteater (*Myrmecophaga tridactyla*) has a narrow head, long snout, small eyes, and round ears. It is covered with stiff gray or brown straw-like hair, which grows up to 16 inches (41 cm) long on the tail. It has a thick, black band with a small, white border running along the body to mid-torso.

The giant anteater's front feet have extremely strong large claws that are used to tear open mounds for food and for defense. When walking, the claws are curled under to protect them, thus the anteater walks on its knuckles. They are also excellent swimmers.

The giant anteater does not have teeth; however, it has a long thin tongue that can reach 20 inches (51 cm) in length. It uses its tongue to get inside ant hills and termite mounds to feed. When threatened, it will stand on its hind legs and strike rapidly with its claws, sometimes hugging the offending animal like a bear.

Giant anteaters are the largest of the South American anteaters with a head/body length of 3.3 - 3.9 feet (1-1.2 m) and a tail length of 2.1-3 feet (0.6-0.9 m). They can weigh up to 90 pounds (41 kg), with the male being larger than the female.

In the wild, it eats insects such as ants, termites, beetles, and insect larvae. It will flick its tongue around 150 times per minute to collect its food. The tongue is coated with sticky saliva during feeding to aid in getting the insects to the muscular stomach that grinds up the insects. This anteater can eat 35,000 insects in a day.

The giant anteater has poor eyesight and hearing, but an excellent sense of smell. There is a lot of communication, especially between infants and their mothers. Snorts, sniffs, hisses, and roaring can be heard when fighting.

In human care, breeding occurs year-long. The gestation period is about 190 days, resulting in a single offspring. The female gives birth standing up and the offspring crawls onto her back where it remains until it is almost half her size (about six to nine months). When born, the infant has a full coat of hair and adult markings. The young will nurse for two to six months and become independent after about two years. They are native to Central and South America, where they are found in tropical forests, savannas, and grasslands.



## PRIMATES

The Primates are a highly diverse order of mammals. They were named, “Primates” because they were thought to be the highest order of animals. Primate is from the Latin primus, which means “prime” or “first rank”.

There are two suborders of Primates, including the Strepsirrhini (lemurs, lorises, pottos, and galagos) and the Haplorhini (tarsiers, Old World monkeys, New World Monkeys, apes).



Here are some characteristics of the Primates:

- Placental mammals with long pregnancies
- Infancy periods requiring extensive parenting
- Pentadactyl (five-digit) hands and feet (some with an opposable thumb)
- Large eyes with increased visual ability (stereoscopic in upper primates)
- Small snouts with decreased sense of smell
- Flexible hands
- Increased brain to body size ratio
- Sense of touch in hands rather than vibrissae (whiskers)
- Increased social behavior
- Less teeth
- Long life spans
- Use learned behavior (in addition to instincts) for survival

These characteristics become more advanced (less primitive) when moving from lower to higher primates. Most primates are arboreal and live in the tropics or subtropics (except macaques). This is probably due to their main diet being fruits, plants and insects that are scarce in certain climates.

## ATELIDAE



Prehensile-tailed monkeys are the largest of the New World monkeys. There are approximately 24 species in this family, including 10 species of howler monkeys (genus *Alouatta*). Howler monkeys are well-studied by scientists.

Named for their vocal abilities, howler monkeys add sound to the New World tropics like macaws and toucans add color. Howlers are often said to be the largest of the New World monkeys, although some woolly spider monkeys may be larger. Their position in size may be challenged, but they are the loudest of the New World monkeys.

Howlers are characterized by an enlarged goiter-like hyoid bone that gives resonance to the voice. The large larynx is covered with a thick beard, giving the howler's head a massive appearance. Howlers also have extremely large protruding jaws and high sloping, bare, black faces. The resonating chambers are larger in males than females, giving the males a louder and deeper sound.

The “dawn chorus” begins each morning as an accelerating series of low grunts by a single male who is then joined by the howls of other males. Females also contribute with higher pitched sounds. This howling continues for several minutes, ensuring other troops have been thoroughly informed of the group's whereabouts, thus reducing potential conflicts. These troop spacing calls, which can be heard from distances of three to four miles (4.8-6.4 km), cease with one long resounding roar. Other troops within hearing distance answer with howls. Different species have somewhat different sounds and pitches. These howling sessions are also heard in the late afternoons. It is believed that one monkey of the group uses soft grunts as an alarm if danger is near.

In addition to marking their area by “howls,” both male and female howler monkeys mark their territory, objects, and other troop members with scent from glands on their throat and perineal area. Male howlers put out a very musky odor when upset.

All howler monkeys show some degree of sexual dimorphism. Females in some species weigh 70-75% as much as males. Howlers are between 16-28 inches (41-71 cm) long (not including a 19-29 inch or 48-74 cm tail) and weigh between 12-24 pounds (5.4-11 kg).

The prehensile tail is a continuation of the spinal column. The continuing vertebrae are joined with ligaments. The tail muscles are attached to the vertebrae by tendons. The tip of the tail curls up, like a hook, as the tail muscles contract. The somewhat flattened tail has a patch of bare skin on the underside. This patch of palm-like skin, about one-fourth of the tail length starting at the tip, increases friction. The grooves (or dermatoglyphics) found on the bare skin resemble fingerprint patterns.

Although howlers do not rely on their tails as much as spider monkeys, they skillfully use them for balancing, anchoring and swatting insects. They are adept at grasping branches as they move methodically and deliberately through the trees. Their hand grip allows them to grasp between the second and third digits (the missing thumb is counted as the first digit). Howlers will hold on to one limb with their hands and grasp another limb with their tail, allowing their young to crawl over the “bridge.”

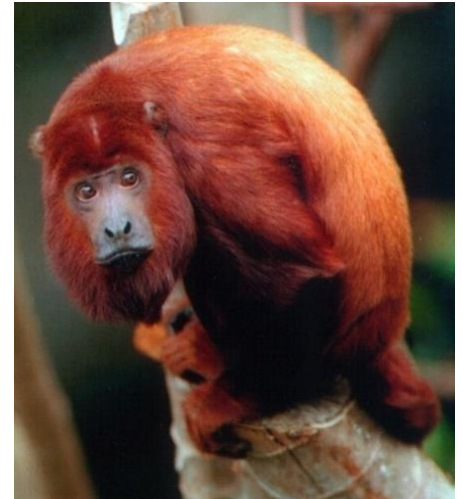
Howlers live in groups ranging from 8-20 members. A troop usually includes one male (possibly two), one to four females per male and the young monkeys. Both troop and territory size depend on population density and food supply. Small groups with abundant food are farther apart in larger marked territories, while more groups and less food cause home ranges to decrease in size and even overlap.

Howlers spend most of their time in the upper tree branches where they feed on large amounts of leaves, fruits, and flowers. They subsist on plant material that is low in energy and slow to digest. These slow-moving primates are believed to spend as much as two-thirds of the day and all the night staying in one area or sleeping. Except for their rambunctious howling, howlers are quite lethargic and harmless monkeys.

Red howlers (*Alouatta seniculus*) are the largest of the howler monkeys. Females are 18-22 inches (46-56 cm) long; males are 19-28 inches (48-71 cm). The tails of both sexes are approximately 18-29 inches (46-74 cm). *Alouatta seniculus* are less sexually dimorphic than some of the other species of howler monkeys. The head, shoulders, limbs, tail and underparts of both male and female are a deep red or purple-black and the sides are often bright golden orange. The color may vary with age and distribution of the animals.

Red howlers (*Alouatta seniculus*) have the widest geographical distribution of all the New World monkeys. They live in the middle and upper levels of the forest throughout the northern half of South America, from Colombia to Bolivia. These rather inactive monkeys usually have small territories in which they do little more than sleep and eat.

Like most howler monkeys, red howlers eat leaves, fruits, and flowers. Red howler monkeys have an advantage over other New World monkeys in that they are better able to subsist on foliage. They have two large sections in their hindgut where bacteria breaks down cellulose. The large gut can take up one-third of their body volume. Howlers are selective eaters and avoid leaves that are unsafe or poisonous. If available, they select young tender leaves that are easier to digest and contain more protein and sugar.



Digestion takes about twenty hours. Red howler monkeys defecate and urinate immediately upon waking when the sun rises. This procedure is believed to be as regular as their “dawn chorus” and at about the same time. Howlers are also known for their defecating and urinating on people below when alarmed. They will also drop branches or other matter from above.

Red howlers live in social groups of up to ten members, with one or two of the individuals being males. Male Red howlers reach sexual maturity at approximately seven years of age; females give birth the first time at around five years of age.





Because of the unbalanced sex ratio, sexual competition between red howler troops is intense. Males are pushed out of their natal troop at sexual maturity and must be admitted into new groups. A red howler male often kills infants in his new group to mate quickly and ensure the new babies are his own. It is believed that female red howlers prefer groups of fewer females and are hostile to new female members. The bigger the number of females, the more likely they are to be the target of a new male who stands to benefit from so many females. Females try to protect their young but are usually unsuccessful; less than 25% of the young howlers survive a male howler invasion.

Red howlers breed throughout the year; however, it is reduced during the early wet season. Births are usually single. Newborns are helpless at first and are carried around on their mother's stomach. A baby can use its prehensile tail within a few weeks, helping to secure itself to its mother. Mothers are not too attentive to their offspring. Females without infants, as well as adult males (after he has killed those that are not his), are attentive or at least tolerant of the infants.

Red howler monkeys live in rather cohesive groups. Unlike most primates, the grooming of each other's fur does not appear to be part of their daily routine. Grooming would probably decrease their infestations of the botfly larvae. Botflies lay their eggs in the hair of the monkeys, and, after hatching, the larvae burrow into their flesh. The damage ranges from discomfort to death, depending on the number of larvae. Howler populations are often ravaged by periodic epidemics of yellow fever, making them easy prey for jaguars and harpy eagles. Loss of habitat, as with most rainforest animals, is a major threat to the red howler monkey. Red howlers are also hunted for their meat, being big enough in size to make the hunt worthwhile.

## CALLITRICHIDAE

Callitrichidae is a family of New World monkeys, which includes the marmosets, tamarins, and lion tamarins.

### Pygmy Marmoset

The Pygmy marmoset (*Callithrix pygmaea*) is the smallest monkey, weighing only two to five ounces (57-142 gr). The French word marmouset means "small boy." Its body is 4½-6 inches (11-15 cm) long with a tail that is longer than the body, seven to nine inches (18-23 cm). They are not sexually dimorphic. Their silky fine fur is honey or medium brown in color. The long hair on the cheeks and head somewhat hides the ears. Their color and size provide good camouflage for living in the trees and hiding from predators such as birds of prey. They are active during the day, particularly in the morning and late afternoon. Although tiny in size, they can jump distances of up to two or three feet (0.6- 0.9 m). The big toes have flat nails; all other digits have claws. At night they sleep in woven vines or tree holes.



Pygmy marmosets are monogamous and live in family groups containing up to four litters and as many as 15 individuals. Twins (sometimes triplets) are usually born twice each year. Gestation lasts 119-142 days.

The adult males or juveniles tend to the babies and carry them until about two months of age, with the mother spending her time with the young only when nursing and cleaning. After two months, the young are independent, and at six months, they reach adult size.

It is believed that both sexes reach sexual maturity between 15 - 17 months. Along with more than ten vocalizations (such as trills, whistles, and clicks), Pygmy marmosets will also raise their hair (piloerection) and use facial expressions to communicate and in threat displays. Sight is their primary sense, but they also have well-developed senses of smell and hearing.



Sap makes up most of their diet. To aid in gnawing, marmosets have long, lower incisors. It is estimated that two-thirds of their feeding time is spent either eating the sap or preparing their food source for the extraction of their next meal. They also eat fruit, insects, small lizards, and spiders.

Pygmy marmosets are found in the flooded forests and plains and river margins of several South American countries (Brazil, Ecuador, and Peru).

## PIED TAMARIN

The pied tamarin (*Saguinus bicolor*) is white on its shoulders and chest, with a dark brown back, hind end, and upper tail. The fur lightens to a rust color on the lower belly, inner thighs, and on the underside of the tail. The bald head has black skin, and it has large ears.

Pied tamarins are arboreal and usually find safety in treetops during the night. These social animals live in family groups of up to 15 members. Grooming is an important part of their behavior. They are a very territorial species whose troops are led by the eldest female.



Males and females are about the same size, weighing approximately one pound (0.45 kg). They are between 8 - 11 inches long (20 - 28 cm); tail length is 14 - 17 inches (36 - 43 cm). The diet of the omnivorous Pied tamarin includes insects, a variety of fruits, plant gums, and flowers but may also feed on reptiles, eggs, and small rodents.



Sight is their primary sense, but they also have a well-developed sense of smell. Scent-marking is used for communication in the group, but they are also reported to use a variety of vocalizations such as whistles and chirps, particularly to defend their territory.

After a gestation period of approximately 160 days, the female usually gives birth to twins. As with other tamarins, the male and older siblings tend to the babies. The geographic range of the pied tamarin is small, found only in a small area of Brazilian rainforest, in and around the city of Manaus.

## EMPEROR TAMARINS

Emperor tamarins (*Sanguinus imperator*) have large moustaches that clearly differentiate them from other species. Emperor tamarins were named for Kaiser Wilhelm II of Germany, who had a long, white mustache. It is thought that their hair features may help to camouflage them as well as assist in mating displays.

The dense coat is gray-black and there are tufts of dark hair around the ears. Their backs are typically yellow, and the chest and tail are red brown. The tail,



approximately 14 inches (36 cm) long, is not prehensile, but does help the tamarin with balance.

The hands and feet are black, with claws on all digits, except for the big toes, which have flat nails. The body length of Emperor tamarins is between 9-11 inches (23-28 cm); adults weigh 12-16 ounces (340-454 gr).

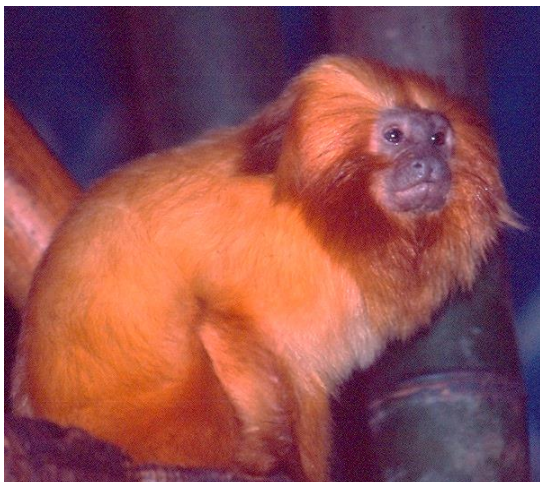
Emperor tamarin groups consist of a dominant female and at least two mature males, plus offspring. The total group size averages six members. The dominant female will breed with all adult males in the group. Since it is impossible to know which male is the father, all males help in the care of the young. Twins are usually born in the spring or summer after a gestation period of 140 to 145 days. Young are weaned in approximately nine weeks; sexual maturity occurs at 20 months.



Emperor tamarins spend much of the day foraging in the treetops where they feed on fruit nectar and insects. Their keen senses of sight and smell assist in locating food and avoiding predators. Communication is through a series of vocalizations to indicate location and as alarm calls. They have a wide array of facial expressions, though not as varied as that of higher primates. Emperor tamarins are primarily found in lowland forests of Brazil and Peru.



## GOLDEN LION TAMARIN



Golden lion tamarins (*Leontopithecus rosalia*) are covered in silky, golden orange hair. This social species is also known as the “red lion monkey” because of its bright color. In addition to its distinct color, it also has a long, striking mane on the cheeks, throat, and ears, surrounding a hairless face.

Male and female Golden lion tamarins are similar in size with an average weight of approximately 1.4 pounds (0.6 kg). Females weigh more during their reproductive stage. They average ten inches (25 cm) in head/body length, exclusive of the tail. They have claws rather than flattened fingernails.

Golden lion tamarins eat fruits, gum, vegetables, small birds, lizards, eggs, spiders, and snails. They hunt for insects by probing with their long, slender fingers into crevices of tree bark. Food is openly shared with family members but rarely outside the family circle.



Golden lion tamarins are usually found in troops of two to eight, generally including family members. They defend their areas with scent markings, vocalizations and/or intense eye contact with an intruder. Males groom themselves as well as females during the day and sleep from dusk until sunrise. There is usually only one breeding pair per troop.

Breeding season occurs during the wettest time of the year (September - March). After a gestation of 130-135 days, twins are born. At birth the infants are covered with fur, eyes are open, and most of the child-rearing is done by the father. The baby will cling to its parents for about five weeks, then the baby begins exploring. Females are sexually mature at 18 months and males at 24 months.

Endemic to Brazil, the golden lion tamarin is one of the rarest of all mammals in the wild. Found in primary and secondary lowland forests of the Atlantic coastline, their current restricted range covers only a few square miles in the Brazilian state of Rio de Janeiro.

## GOLDEN-HEADED LION TAMARIN



The Golden-headed lion tamarin (*Leontopithecus chrysomela*) is also known as “little monkey with a golden face” because of the golden-orange mane around its hairless face. The body is black with golden fur on part of its tail, hands, feet, and forearms. Males and females are quite similar in appearance. Like other callitrichids, claws are found on all but the big toe, which has a flattened nail.

The head and body measure ten inches (25 cm), with the tail being only slightly longer than the head and body. They weigh between 1.2-1.3 pounds (0.54-0.59 kg), with females being larger than males. The diet is mostly fruit and gum, with some animal prey. They are less dependent on gums during the dry season than other lion tamarins. Sight is their primary sense, but they also have a well-developed sense of smell.

Groups range from five to eight members. A dominant male leads the group. Both multi-male and multi-female groups are known to occur. Golden-headed lion tamarins tend to travel further during the day than other species of this genus. These diurnal tamarins are active for 9 - 12 hours each day and spend most of their time in tropical forest at heights between 10 to 33 feet (3-10 m). They sleep as a group, high up in tree cavities.

Golden-headed lion tamarins have several categories of vocalization based on behavior and activities, including whines, trills, clucks, and long calls. When frightened, in danger, or defending its territory, the brightly colored mane is raised, making it look larger in size.

Females reach sexual maturity at approximately 18 months, and males at 24 months. Breeding occurs mostly during the warm and wet season, September through March. The gestation period is 125-132 days. Twins are usually born, with males and elder siblings caring for and rearing the babies.

Golden-headed lion tamarins are found only in Brazil. Due to habitat destruction (their main threat), they are confined to the southern part of the state of Bahia, Brazil.

## RED-HANDED TAMARIN

The red-handed tamarin (*Sanguinus midas*) has a mottled black body, with yellow highlighting and golden red hands and feet. There are claws on all digits except for the big toe, which has the flattened nail. Their average height is 7.5 - 8.25 inches (19 - 21 cm); weight is 9 - 13 ounces (255 - 369 gr), with males being larger than females.

Arboreal, diurnal Red-handed tamarins typically live in groups of 4-15 individuals, of which only one female will breed. The breeding female usually gives birth to twins twice a year, after a gestation period of 140 to 170 days. Young are weaned after about two to three months and are cared for primarily by the father and turned over to the mother only to nurse, however, the entire group helps with the care of the young.



Their diet includes insects, ripe fruits, gum, nectar, buds, flowers, frogs, lizards, nectar, snails, and spiders. Red-handed tamarins live in northern Brazil, Guyana, French Guiana, and Surinam where they are found in open canopies of primary and secondary rainforests.

## PITHECIIDAE

The family Pitheciidae was formerly in the family Atelidae. Pitheciidae now includes titis, saki monkeys and uakaris.

## BEARDED SAKI

Red-backed bearded saki monkeys (*Chiropotes chiropotes*) have a thick beard that extends down from their jaws, which is particularly evident in males. The hair on top of the head parts down the middle and puffs out on each side. Their bodies are covered with dense hair that is mainly black, but their backs vary in color from red to yellow gold. The non-prehensile, bushy tail is almost as long as the body.



Bearded sakis form large troops of up to 30 members but separate into smaller groups when they travel and forage for food. Saki monkeys move easily through the forests as their strong hind limbs allow them to jump long distances. They sleep high in the forest with their tails curled around their bodies.



Red-backed bearded sakis are medium-sized monkeys. The females of the species are typically smaller. Males are approximately 16-18 inches long (41-46 cm), with an average weight of between 5.7-7.1 pounds (2.6-3.2 kg). Red-backed bearded sakis feed primarily on seeds, nuts, and fruits, but will also eat arthropods.

Their sense of smell is used for foraging and social communication during mating. Sounds include whistles and twitters. Both vocalizations and body language are used to communicate. Tail wagging is a warning of danger.

After an approximate five-month gestation period, the female usually gives birth to a single offspring. The tail is prehensile during its first two months after birth, allowing it to cling to its caregiver.

The bearded saki is both diurnal and arboreal and can usually be found in the upper rainforests that are located near streams or rivers. It is believed their range includes Brazil, Venezuela, and possibly the Guyanas.

## WHITE-FACED SAKI

White-faced sakis (*Pithecia pithecia*) are sexually dimorphic. The males are glossy black, with a white face and black snout. Females are brown, with a black face and white stripes along the nose.

Newborns of both sexes are the color of females, which changes after around two months. Both sexes possess a long, bushy, non-prehensile tail. White-faced sakis are, on average, 12-20 inches (30-51 cm) in length, with males being somewhat longer. Males are significantly heavier, weighing up to 5.5 pounds (2.5 kg), while females only reach 3.8 pounds (1.7 kg). The tail may be up to 18 inches (46 cm) long.



White-faced sakis prefer the larger branches of the lower canopy and can be observed on the ground. They live in small family groups, consisting of the parents and two to three offspring. They use all four limbs for walking and leaping. They have been observed leaping over 30 feet (9 m) from one tree to another.



Sakis feed on fruits, leaves, flowers, seeds, and small other prey such as insects, bats, and rodents. They can crack open hard nuts with their canine teeth. Sight is their primary sense. The White-faced saki is capable of an impressive display when threatened - its hair rises and its entire body shakes. Their vocalizations range from shrill to roar-like.

Mated pairs of *Pithecia pithecia* usually bond for life. A single baby is born each year, after a gestation period of 163-176 days. The young are weaned after four months and are sexually mature at two to three years of age. They live in secondary, savanna, and marsh forests of Brazil, Guyana, French Guiana, Surinam, and Venezuela.

## RODENTIA

Rodentia is derived from the Latin verb “rodere” which means to gnaw. Rodentia is the single largest group of mammals (over 2000 living species placed in about 30 families, over 400 genera and 1,800 species) with more than 40% of all species of animals, belonging to the order Rodentia. Most people are familiar with mice, rats, hamsters, and guinea pigs, which are commonly kept as pets. The Rodentia also includes beavers, muskrats, porcupines, woodchucks, chipmunks, squirrels, prairie dogs, marmots, chinchillas, voles, lemmings, and many others. Rodents, native on all continents except Antarctica, are characterized by a single pair of continuously growing incisors in each of the upper and lower jaws that must be kept short by gnawing.

### Dasyproctida

This family contains 13 species in 2 genera. They are restricted to tropical parts of the New World.

## CENTRAL AMERICAN AGOUTI

The Central American agouti is similar in body shape to a guinea pig, but with longer legs. The coat ranges from pale orange to dark brown on the back, with yellow or white on the belly. The rump is a contrasting color. In some individuals, inconspicuous stripes may be present. The fur of the agouti is coarse, yet glossy. The tail is very small.

The basic social unit of the agouti is made up of a pair that mate with one another for life. Agoutis are diurnal and terrestrial. They will hold fruit in their front paws while eating. They are fast and agile, moving by walking, trotting, galloping, and jumping. They spend much of their time grooming.



Males and females are similar in size, reaching two feet (61 cm) in length and weighing up to nine pounds (4 kg). Agoutis feed primarily on fruit and nuts. When eating, they often sit on their hind legs and hold the food in their front paws. Central American agoutis have very good vision and a highly developed sense of smell. When alarmed, agoutis will give a sharp bark like a small dog. They will stomp their feet as a threat display.



Central American agoutis breed throughout the year, but most offspring are born between March and July. The gestation period is between 104-120 days, usually with a litter of two infants. The female has one or two litters a year.

Central American agoutis inhabit undergrowth of rainforest and savanna from the states of Tabasco and Chiapas in southern Mexico to southern Bolivia and

northern Argentina. They are usually found near water.

## SIRENIA

Sirenians (manatees and dugongs) were named for the sirens of ancient mythology. A siren was a beguiling, feminine, aquatic creature with a hauntingly beautiful voice that lured sailors to their deaths. Some believe that reported mermaid sightings were Sirenian sightings.

Commonly referred to as “sea cows,” sirenians are the only aquatic mammals that are herbivores. Sirenians live in warm, shallow, tropical and subtropical waters where plants receive the necessary sunlight for growth.



Despite having similar adaptations, habitats, and physical features as seals and sea lions, sirenians have no evolutionary relationship with other marine mammals. Sirenians are believed to be the descendants of elephants, aardvarks, and hyraxes.



Ungulates include species with an even number of “toes” (Artiodactyla), such as pigs and cattle, and species with an odd number of toes (Perissodactyla), such as zebras, rhinoceroses, tapirs, and horses. The subungulates include sirenians, elephants, hyraxes, and aardvarks. Studies that support this common ancestry point out certain anatomical features shared by most, such as similar dentition, absence of a collar bone, and nails or hooves rather than claws. Except for the ant/termite-eating aardvark, these animals are herbivores.

Sirenians have the following distinguishing features:

- a fusiform, streamlined body
- no external pelvic limbs
- flippers (small pectoral limbs)
- bones that are thick, solid, and heavy
- no neck
- small cranial cavity and brain compared to body size
- specialized teeth
- horny pad in the mouth of most to help chew plant material
- limited body hair
- large body

Sirenians include two families, including the Trichechidae (manatees) and Dugongidae (dugongs). There are four living species of Sirenians.

## Dugongidae

The dugong (*Dugong dugon*) is found in 43 countries throughout the Indo-Pacific region which includes the Red Sea, Indian and Pacific Oceans (Australia, India, East Africa, Persian Gulf, Philippines, and other South Pacific islands). They are the most abundant of Sirenians. Dugongs, usually found in salt water, are the most marine of the sirenians. On rare occasions, they have been found in the mouth of rivers. Dugongs do not migrate as far as manatees.

The average size of a dugong is about nine feet (2.7 m) in length and 600 pounds (272 kg) in weight. They eat bottom-growing seagrasses and typically feed at night. They have incisors (or tusks) that can be seen, particularly in the males. Their muzzle turns downward and ends with the rostral disk (a wide flattened area). Dugongs have smooth skin, flippers with no nails, and a notched tail fluke. Humans, sharks, and crocodiles are their major predators.

## Trichechidae



The Amazonian manatee (*Trichechus inunguis*) is found in the Amazon River basin and its tributaries. It is the only sirenian that lives exclusively in freshwater. Because lowered water levels during the dry season limit the amount of available vegetation, the Amazonian manatee's low metabolic rate and fat deposits allow it to survive for perhaps as many as 200 days without eating.

This species has no nails on its flippers and has smooth skin with irregular white or pink patches on its chest and abdomen. Compared to other species of manatees, Amazonians have longer front limbs, smaller teeth, and a slimmer, longer snout. The Amazonian manatee is the smallest of the living manatees, averaging eight feet (2.4 m) in length and weighing approximately 800 pounds (363 kg).

Amazonian manatees are preyed upon by man, sharks, jaguars, and caimans.

The West African manatee (*Trichechus senegalensis*) is found in the shallow coastal areas, rivers, and estuaries of West Africa. They live in salt, brackish, and sometimes, fresh water. There is very little known about this species, which closely resembles the West Indian manatee in habits and appearance. Since there is a lack of bottom vegetation available, a downward pointing snout is of less value for this species. West African manatees average about 10 feet (3 m) in length and weigh approximately 1,250 pounds (567 kg). Man is the main predator; however, sharks and crocodiles have been seen preying on West African manatees.

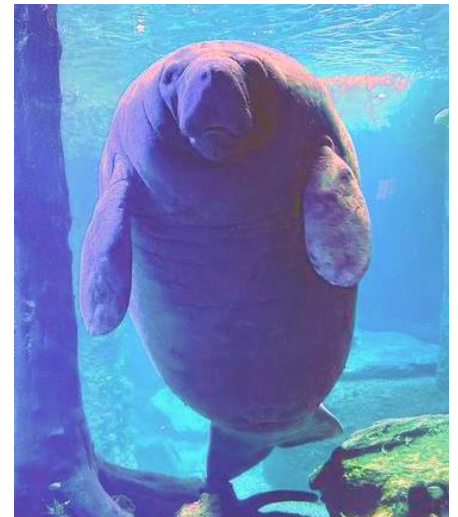
Until 1986, the West Indian manatee (*Trichechus manatus*) was made up of a single species. At that time sufficient skeletal differences led to the naming of two subspecies: the Antillean manatee (*Trichechus manatus manatus*) and the Florida manatee (*Trichechus manatus latirostris*). In addition to the skeletal differences, the two subspecies are geographically isolated. It is believed by many scientists that deep canyons in the Gulf of Mexico keep the subspecies apart. Most manatees will not venture into water over 40 feet (12 m) deep.

## SIRENS OF THE SEA

Manatees are large, gentle mammals who live their entire life in water. They are usually found 3 - 10 feet (0.9 - 3 m) below the surface of shallow coastal waters, estuaries, and slow-moving rivers where there is sufficient light for plant growth.

Sirenians are the only aquatic mammals that are plant-eaters (herbivores). Their food consists of submerged, overhanging, floating and shoreline plants. Marine vegetation often consists of turtle, shoal, manatee, and widgeon grasses. Preferred freshwater vegetation includes hydrilla, eel grass, water lettuce, and water hyacinths.

The metabolic rate of the herbivorous manatee is low compared to other aquatic mammals. When not grazing or moving about in search of food, manatees are usually resting. Manatees rest by lying on the bottom or floating near the surface of the water.



Their bones are very dense, helping them dive and remain on the bottom while grazing. The deepest a manatee has been seen diving is around 30 feet (9 m). Normally they feed where plant life is available; usually no deeper than 10 feet (3 m) below the surface of the water. Manatees are not deep diving animals like dolphins or whales; therefore, their muscle content is quite different from other marine mammals.

There is less hemoglobin in the muscles of manatees than is typical in other diving mammals. This means that manatees cannot store as much oxygen as seals and dolphins, preventing them from diving for long periods or at depth. The long bones and ribs of manatees lack marrow cavities, making their skeleton relatively heavy and dense.



Buoyancy is maintained by blubber and large lungs that are flat and long. Both the lungs and diaphragm span the entire length of the body cavity, helping the manatee float horizontally. Each lung is in a separate cavity. If one lung becomes infected, the other seems to function normally.

Instead of one diaphragm like humans, manatees have “hemi-diaphragms”. Although they look fat, manatees have little body fat. Plants they eat have low nutritional value so they must eat a lot. Large amounts of intestinal gas created by microorganisms for digestion also assist in their buoyancy.

To accommodate the large volume of high-fiber food, the intestines are long, sometimes up to 150 feet (46 m). The bacterial breakdown of cellulose occurs further along the intestinal tract. It takes approximately seven days for a manatee to digest food.

The average size of a West Indian manatee is 10 feet (3 m) in length and 1,000 pounds (454 kg) in weight. Despite their large size, these mammals are quite agile and streamlined. Manatees have only six neck vertebrae (most mammals have seven) and are unable to move their heads side-to-side. They must turn their whole body around to see behind.

Manatees swim at an average of 2.5 - 6 miles (4 - 9.7 km) per hour but can reach speeds of up to 15 miles (24 km) per hour for short distances. The tail helps propel the manatee through the water. The two flipper-like forelimbs are used for steering. The fused bone structure of the flippers is like that of toothed whales, sea lions and seals (five digits covered with thick skin).

The skin is gray black at birth and becomes lighter within a few weeks. Adults are gray to gray/brown. Their skin is wrinkled, rough and tough. Many manatees, particularly those in Florida, have long, parallel scars from propeller wounds. Deep scars can be seen on manatees forever, while superficial wounds may heal completely.

Bleeding stops quickly due to a chemical in the blood of marine mammals that causes the blood to clot when hit by water. This adaptation prevents manatees from attracting predators or bleeding to death. Manatees in saltwater often have barnacles attached to them; freshwater manatees are sometimes covered with algae. Single, bristly hair can be seen on their bodies with thicker whiskers growing on their blunt snout.

Antillean manatees are nocturnal and diurnal, doing the same amount of intermittent feeding and resting during the night and day. They feed on aquatic plants such as water hyacinths, water lettuce, and seagrass. Antillean manatees feed on marine, estuarine, and freshwater vegetation and can eat up to 10 -15% of their body weight in wet vegetation each day.



Although they feed underwater, they push most of the water back out before swallowing, making the contents of their stomach mostly dry. They have large salivary glands for lubricating and assisting with digestion. Sometimes mollusks, crabs, sea squirts, and other small animals are attached to the seagrass and are inadvertently eaten.

Most of their feeding occurs during the wet season when vegetation is readily available in flooded backwaters. As the rivers dry up, Antillean manatees return to the main riverbeds or migrate to deeper bodies of water where there is little or no food. They may go without food for several weeks until vegetation becomes available.

It is believed that all manatees require freshwater (in addition to that obtained from the food they eat) and are often seen drinking from culverts, hoses, or other freshwater sources. Their kidneys filter blood to control levels of salt and to maintain water balance. Dugongs, mainly found in salt water, have kidneys that are different from those of manatees and may be able to better eliminate salt ingested with their food.

It is believed that Antillean manatees once lived in larger herds. However, it is now unusual to see more than four to six animals in one group. Manatees are often solitary or with their young (calf). Seeing manatees in their natural habitat is difficult, particularly if the water is muddy and full of vegetation. Their presence may be given away when their nostrils break the water surface for air. Sometimes a puff or snort can also be heard as they breathe. It is believed that as much as 90% of the air in their lungs is renewed in a single breath (humans renew about 10% of the air in their lungs with each breath).

Manatees can hold their breath for as long as twenty minutes. They normally breathe every three to five minutes and more often if expending a lot of energy. Their presence may also be detected by watching the water surface for manatee droppings. Because they eat a lot, they also defecate a lot. Their large, round droppings, made up of disintegrated fiber, float to the top of the water.

Manatees travel through the water by moving their paddle-shaped tails in an up-and-down motion. Manatees have rounded, horizontally flattened tails, like dolphins and whales. The forelimbs are modified pectoral flippers used both for maneuvering while swimming and manipulating food. Like all other manatees (except the Amazonian), Antilleans have three or four nails on their flippers. There are no visible hind limbs.

The brain of the manatee is very smooth and quite small for such a large animal. They do not have convolutions or “folds” on the surface of the brain that are usually associated with higher intelligence. Manatees use their senses of smell, sight, sound, taste, and touch. Their nostrils are closed by valves while underwater. It is believed that olfactory tissues on small nasal bones give manatees the ability to smell.

The senses of smell, sight, and/or taste are used by manatees to avoid specific plants that are toxic. Although small (about 0.8 inches or 2 cm in diameter), the eyes of manatees are well-developed. Manatees do not have eyelids. Their eyes close in a circular motion, somewhat like an aperture on cameras. A nictitating membrane closes over the eye for protection when underwater.



Sirenians have no external ear but have extremely large ear bones and appear to have adequate hearing. The tiny ear openings are located several inches/centimeters behind the eyes. Underwater vocalizations (described as chirps, whistles, or squeaks) are used to express fear, anger, sexual arousal or to establish contact. Mothers can respond to the sounds of their young from distances of more than 200 feet (61 m).

Touch and body contact seem important for manatees, particularly between a mother and her offspring. The flexible upper lip is lined with coarse whiskers (vibraissae) and are well-supplied with individual nerve endings. These whiskers are very sensitive to touch and provide information about close surroundings.

The upper lip is split down the middle, allowing each side of the mouth to move independently. The lower jaw and upper palate are covered with horny pads that help grasp and tear apart the vegetation. Having only molars and no biting teeth, manatees use their broad, flat teeth for grinding plants. Adult manatees have no front teeth.

A manatee's teeth are replaced constantly throughout their life as they wear down from grinding on sediment attached to plants. Most other mammals replace only one set of teeth in a lifetime. New teeth come in at the back of the jaw and move forward, as if on a conveyor belt, as the front molars fall out. Teeth are replaced horizontally, as opposed to vertically in most other mammals. Most terrestrial mammals have vertical and discontinuous tooth replacement (only one species of kangaroo has horizontal tooth replacement). Manatees have six to eight molars in each of the two upper and two lower rows of teeth. Dugongs have a pair of exposed tusk-like teeth. These upper incisors are not usually seen in female dugongs.

Female manatees are usually larger than the males. Sex of the animals can only be determined by the position of the genital openings: they are close to the tail on females and near the navel on males. Antillean manatees may mate and give birth throughout the year; however, it is believed that most are born during the spring and summer. The gestation period is approximately twelve to thirteen months, usually resulting in one infant. Females give birth once every two to five years. An Antillean manatee calf measures between 48 - 54 inches (122 - 137 cm) in length and weighs between 60 - 70 pounds (27 - 32 kg) at birth.

After birth, the calf immediately swims on its own and surfaces for air. Mothers (cows) nurse their young for an extended period. Newborns get their milk from a pair of nipples, one under each pectoral flipper. Manatees have no storage sacs for their milk glands; therefore, the calf must suckle frequently for short periods of time. Calves start to supplement their diet with plants a few weeks after birth, but they often depend on their mother for up to two years. Males do not stay with the females and do not help care for the young.

Manatees have a slow reproductive rate. It is estimated that females become sexually mature when they reach a body length of about 8.5 feet (2.6 m); females being approximately five to eight years and males nine to ten years of age (age being determined by the annual growth rings in the ear bones).

Despite a life span of 50-60 years, deaths occur at a much higher rate than births. Natural causes such as starvation, predation, and disease still exist, often occurring when manatees are trapped in dried up areas. Antillean manatees are prey to such animals as jaguars, crocodiles, caimans, and sharks. Most notably, it is the human-related causes of death or injury that are of extreme concern. Accidents related to boats, dams, and fishing (lines, traps, and nets) continue to kill manatees.

Manatees, being tropical or subtropical, have very little body fat, thus are highly susceptible to cold. Manatees start moving to warmer areas when the water temperature drops below 68° F (20° C). Loss of habitat is the biggest threat to the manatee. Longer dry seasons caused by the depletion of forests threaten both the water and food supplies for manatees. Substances such as mercury (used in mining), herbicides, and other toxins end up in the water systems and can cause sickness and death.

Although hunting of Antillean manatees has been prohibited for many years, it continues, particularly in remote areas where manatee hunting is a skill passed from one generation to the next. One would assume that not much skill is required to catch the slow, shy, and gentle manatee, however, hunting practices still exist.

The tough, thick manatee hide has been used for years to make clothes, war shields, belts, hoses for machinery, and more. Ribs and tusks were used as ivory. Manatees were hunted for food in the U.S. until around 1950. Considered a delicacy by many locals, the mild flavored fatty meat was fried in oil from the same animal. In some parts of the world, dugongs and manatees still supplement meager diets.

In November 1741, Russian Captain Vitus Bering and his crew shipwrecked on an island off the coast of a Siberian peninsula. A crew member named Steller was credited with discovering a huge animal that was later named Steller's sea cow (in the Dugonidae family). The partly submerged marine mammal stayed in shallow water looking for food. Totally unafraid of predators, the sea cow was easy prey for the men. Their meat, oil and hides kept the crew alive through the winter. After the crew left, the islands became favorite stopping spots for hunters who enjoyed the meat of the sea cows while harvesting furs. It is believed that some two thousand sea cows existed when first discovered. By 1768, the Steller's sea cows had all been killed.

The now extinct Steller's sea cow was huge, averaging 30-35 feet (9.1 - 10.7 m) long, 22 feet (6.7 m) around, and three to four tons (2,722-3,629 kg) in weight. Steller's sea cows had no functional teeth and exclusively ate marine algae. These gentle, slow-moving, harmless animals were eliminated by humans in only twenty-seven years.

Manatees are an "indicator species", gauging the health of the ecosystem in which they live. These animals depend on aquatic vegetation for survival which is found in nursery and feeding areas for recreational and commercial species of fish and shellfish. The same vegetative areas help clean coastal waters by absorbing contaminants.



The Steller's sea cow is now like an imaginary creature of our past, but an excellent example of what can (and will) happen to the existing manatees and dugongs without our concern and protection. Manatees are an endangered species.

## USEFUL VOCABULARY

|                       |   |
|-----------------------|---|
| adaptation            | a change or adjustment that is evolved to fit the environment   |
| agile                 | active, moves quickly   |
| altricial             | immature and dependent at birth, requiring care from birth  |
| aquatic               | living in water   |
| arboreal              | living in or frequenting trees  |
| barnacles             | marine crustaceans with feathery appendages for gathering food, free-swimming as larvae but fixed to rocks, animals, logs, etc. as adults |
| binocular             | using both eyes   |
| body language         | visual communication method, such as posturing or facial expressions  |
| botfly                | flies that have parasitic larvae that live in body tissue of animals, causing severe pain or sometimes death                              |
| brachiation           | moving by swinging arm over arm from branch to branch   |
| brackish              | a mix of fresh and salt water   |
| buoyant               | tending to float  |
| camouflage            | a disguise or concealment   |
| canine                | strong, pointed teeth between incisors and molars   |
| carnivores            | meat-eaters   |
| carpel whiskers       | sensory hairs on the back of the forelegs   |
| carrion               | the dead and rotting flesh of an animal   |
| cellulose             | the chief constituent of all plant tissues and fibers   |
| channel               | a route between two bodies of water   |
| chestnut              | a deep red-brown color  |
| chromosomes           | organized structure of DNA and protein found in cells carrying genetic information  |
| cohesive              | act of staying or sticking together   |
| copious               | plentiful, abundant   |
| defecate              | to get rid of waste matter; have a bowel movement   |
| density               | the compactness or crowding of parts: high mass per unit volume   |
| dental comb           | structure used for cleaning debris off the projecting front teeth of prosimians   |
| dew claw              | first toe on the foot of cats that is on the side of the foot   |
| dexterous             | skillful in physical movements, particularly of the hands   |
| digitigrade           | walk on toes with back of foot raised   |
| disruptive coloration | spots, stripes or other markings that break up the body outline against the background or surroundings                                    |
| diurnal               | active during the day   |
| docile                | submissive, accommodating   |

|                  |   |
|------------------|---|
| domesticated     | tame, not wild  |
| dominance        | one person or group having power over another   |
| dorsal           | referring to the back of an organism  |
| endangered       | at risk of extinction   |
| estuary          | mouth of a river, where a river joins and meets the sea   |
| excrement        | feces   |
| extinct          | no longer in existence  |
| felines          | cats  |
| fermenting       | a process in which an agent causes an organic substance to break down   |
| fetus            | an unborn or unhatched vertebrate   |
| fissipeds        | “paw-like” land carnivores  |
| flank            | the side, between the ribs and hip  |
| flipper          | a flat, wide limb with bones that is used for swimming, steering, or manipulating   |
| folivore         | leaf eaters   |
| forage           | search for food   |
| freshwater       | water without salt  |
| functional       | having a purpose  |
| genial whiskers  | sensory hairs that are back on the sides of the face  |
| gestation period | length of time in the womb  |
| harem            | a group of females shared by a single male  |
| herbicides       | chemicals used to destroy or inhibit plant growth   |
| herbivores       | plant eaters  |
| hyoid            | u-shaped bone at the base of the tongue that supports the tongue muscles  |
| incisor          | one of the cutting teeth in mammals in front of the canines   |
| infanticide      | the act of murdering an infant  |
| insectivores     | insect-eaters   |
| keratin          | protein that occurs in hair, feathers, nails, hooves, etc.  |
| knuckle-walking  | move on all four limbs with forelimbs flexed so that weight rests on the knuckles   |
| larynx           | cavity in the throat containing the vocal chords  |
| legislative      | law making  |
| ligaments        | a tough band of tissue connecting bones or supporting organs  |
| litter           | a number of young born to an animal at one time   |
| mammals          | warm-blooded vertebrates that feed their young with milk from mammary glands, give live birth (except monotremes) and have hair on their body |
| mammary glands   | the organs that secrete milk  |
| marine           | of or relating to the sea   |
| marsupials       | mammals that care for their young in a pouch  |



|                    |   |
|--------------------|---|
| melanistic         | black color resulting from an abnormal amount of black pigment  |
| membrane           | pliable connective tissue or lining that connects organs or cells   |
| migration          | a seasonal movement from one area or region to another  |
| molar              | one of the teeth in mammals behind the incisors and canines used for grinding                             |
| monogamous         | having a single mate during a period of time  |
| monotremes         | mammals that lay eggs and feed their young from a mammary gland   |
| muzzle             | forward projecting part of the head, including the jaws and nose  |
| mystacial whiskers | sensory hairs on the side of the face   |
| mythology          | study of fictitious stories associated with a culture, person or thing                                    |
| New World          | American continents   |
| nocturnal          | active during the night   |
| nonaggressive      | not offensive or hostile  |
| nonterritorial     | not limited to a specific area or space   |
| Old World          | those places known to Europeans before the Americas were discovered                                       |
| olfactory          | concerned with smell  |
| omnivore           | feeds on both plants and animals  |
| opportunistic      | feeds on whatever food is available   |
| opposable thumbs   | digits on same limbs that can be brought together in a grasping action, can hold objects                  |
| papillae           | small fleshy projections  |
| pectoral           | on or near the area of the breast or chest  |
| pendactyl          | an animal with a five-digit limb structure  |
| pendulous          | bent downward   |
| pinniped           | a member of the suborder Pinnipedia, such as a seal or walrus, with all four limbs modified into flippers |
| piscivorous        | feeding on fish   |
| placenta           | the vascular organ that unites the fetus to the mother's uterus   |
| placentals         | mammals that nourish their unborn in the mother's body through the placenta                               |
| plantigrade        | animals that place the full length of the foot on the ground during each stride when walking              |
| polyandrous        | a female that mates with more than one male in the same breeding season                                   |
| polygamous         | a male that mates with more than one female during the same breeding season                               |
| polygynandrous     | multi-male, multi-female polygamous mating system   |
| pouch              | a pocket-like structure in which marsupials carry their young   |
| predation          | the act of preying upon others  |
| prehensile         | adapted for grabbing by wrapping around an object   |
| primitive          | relatively undeveloped, marked by lack of skill   |
| prodigious         | great in number or size   |

|                       |  |
|-----------------------|--|
| prohibited            | forbidden, not allowed   |
| quadrupedal           | moving on four legs  |
| resonating            | sound with a vibrating amplification   |
| resonating chamber    | space where sound is reverberated  |
| retractive            | can be drawn back in   |
| scent mark            | the leaving of special glandular secretions and/or urine to mark territory   |
| sediment              | matter that settles or attaches to the bottom of things  |
| sexual dimorphism     | differences in shape, color or size between males and females of same species  |
| sirens                | mythical half women that used enchanting music to lure sailors to rocky islands  |
| social                | animals that breed or live in colonies or organized communities  |
| strepsirhines         | prosimians, lower primates   |
| sublingual            | under the tongue   |
| suckle                | to nurse from a mammary gland or teat  |
| suffocate             | obstruct the air passage   |
| superciliary whiskers | sensory hairs above the eye  |
| syndactylous          | an animal that has two or more toes fused together   |
| taxonomists           | those who classify organisms into groups   |
| taxonomy              | classification of organisms that shows relationships between them  |
| tendons               | tissues connecting fleshy parts of muscles   |
| terrestrial           | living on the ground (as opposed to the sea or air)  |
| territorial           | limited to a specific area or space  |
| thermoregulate        | the ability of an organism to keep its body temperature within certain boundaries, even when the surrounding temperature is very different |
| toxins                | poisonous substances   |
| tributaries           | rivers that feed into larger rivers  |
| troop                 | group of animals   |
| tufts                 | a cluster of hair or feathers  |
| uterus                | an organ of the female mammal for containing and nourishing the young during development before birth                                      |
| vascular              | relating to a channel (or a system of channels) for the movement of a fluid (such as blood or sap)   |
| ventral               | referring to the underside of an organism  |
| vertebrates           | animals with a spinal column   |
| vibrissae             | stiff, coarse, sensitive hairs or whiskers on the head and/or face of some animals   |
| warm-blooded          | having a body temperature that remains relatively constant   |