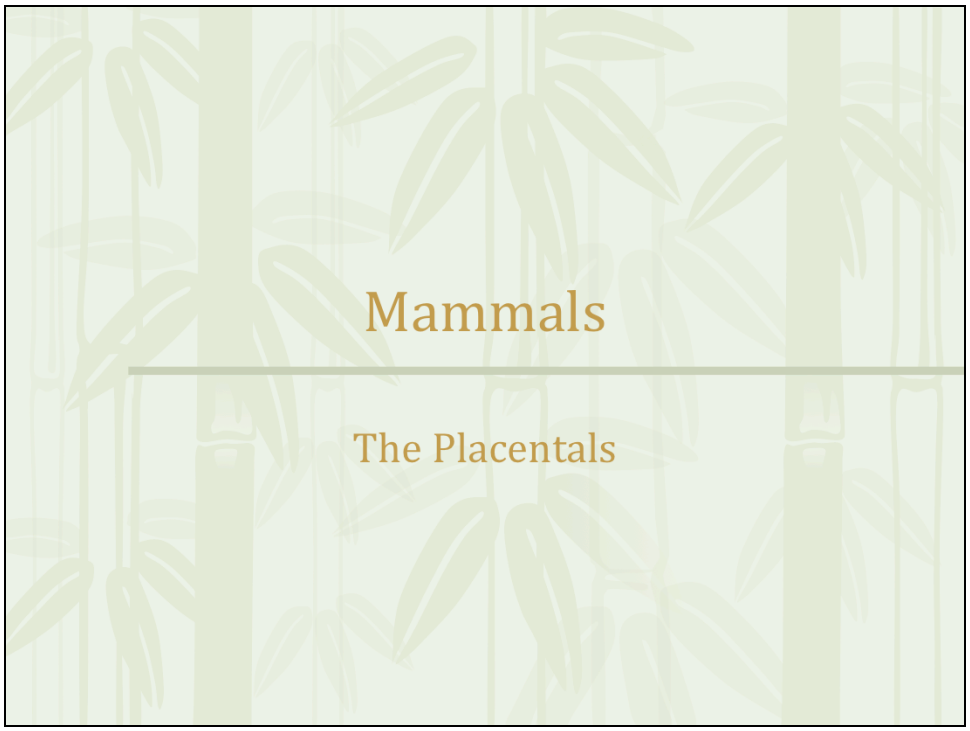
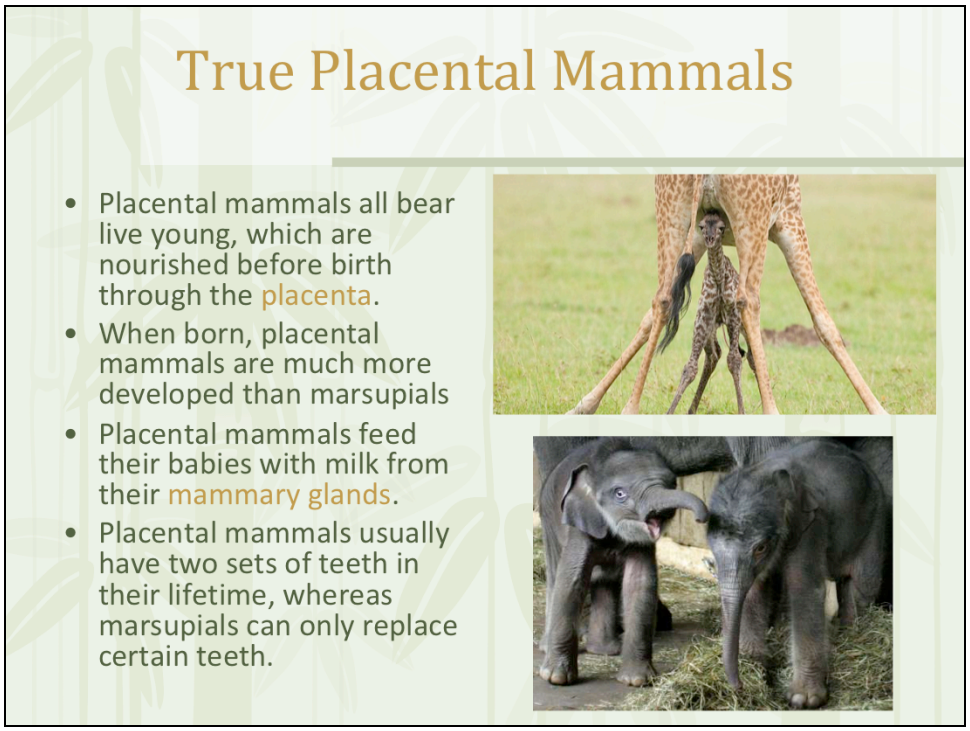


The last group of mammals have a true placenta. The placental system is considered more advanced than the monotreme and marsupial reproductive systems. Placental mammals all bear live young, which are nourished before birth in the mother's uterus through the placenta. Longer gestation periods allow placental mammals to give birth to relatively large and mature infants. The placental method of mammal reproduction requires a greater maternal investment of time and energy than does non-placental, but results in greater benefits to the infant. The babies are protected inside the mother for a longer period, allowing for more complex development.

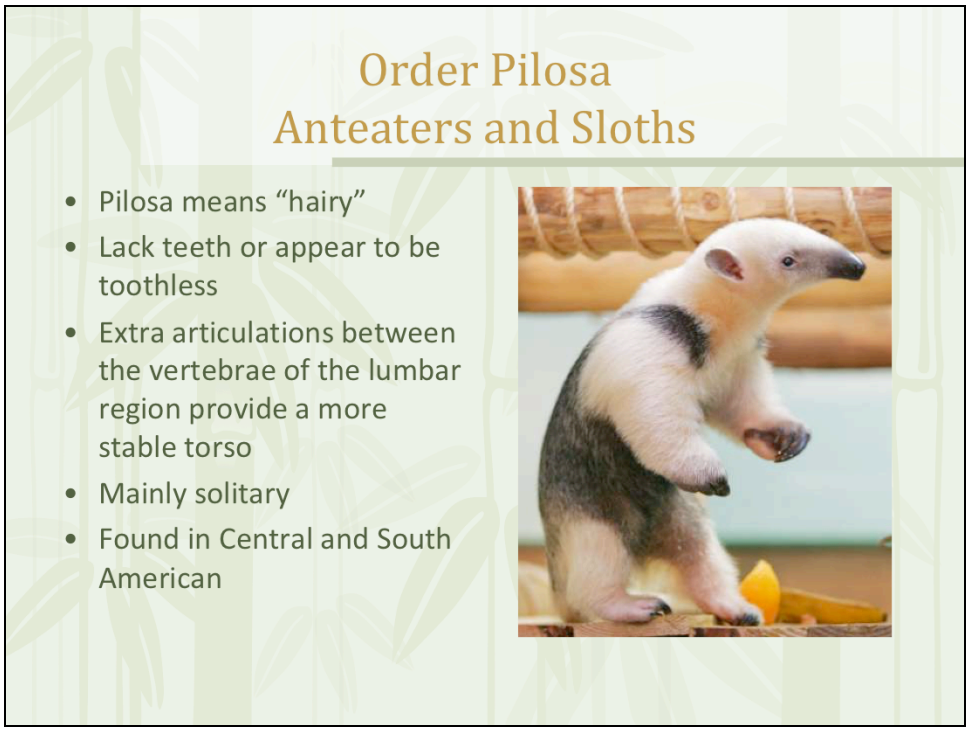


An unborn fetus develops inside the mother's uterus. The placenta provides the oxygen and nutrients the fetus needs to survive. The placenta is usually passed out of the body after the fetus is born. The embryos developed by the live-birth method are not endangered by temperature change, desiccation, or oxygen deprivation but there is an extra cost to the parent.

When born, placental mammals are much more developed than marsupials due to their longer gestation periods. Smaller species normally have a shorter gestation period than larger animals. The degree of development of the newborn varies among species. Humans have a relatively long gestation period compared to the rest of the animal kingdom and are born underdeveloped compared with other primates. Developing young get their first nourishment from their mother's milk.

Most primates, all hoofstock and the marine mammals are born **precocial**; they are able to move around on their own shortly after birth and have camouflage colors and cryptic behaviors to avoid predation while trailing their parents and nursing until thay are capable of feeding on their own. Females of precocial species have longer gestation periods. The degree of development varies among precocial species, as does the amount of parental care required. Hoofstock need to be able to get up and move with the protection of the herd.

Most rodents, many carnivores, and bats have blind, sometimes hairless, weak-limbed young that must be cared by adults. They are born **altricial**, meaning "requiring nourishment." Precocial and altricial strategies have both contributed to the evolutionary success of mammals; there are selective advantages to feeding ones young nutritional and antimicrobial milk from the mother's mammary glands.

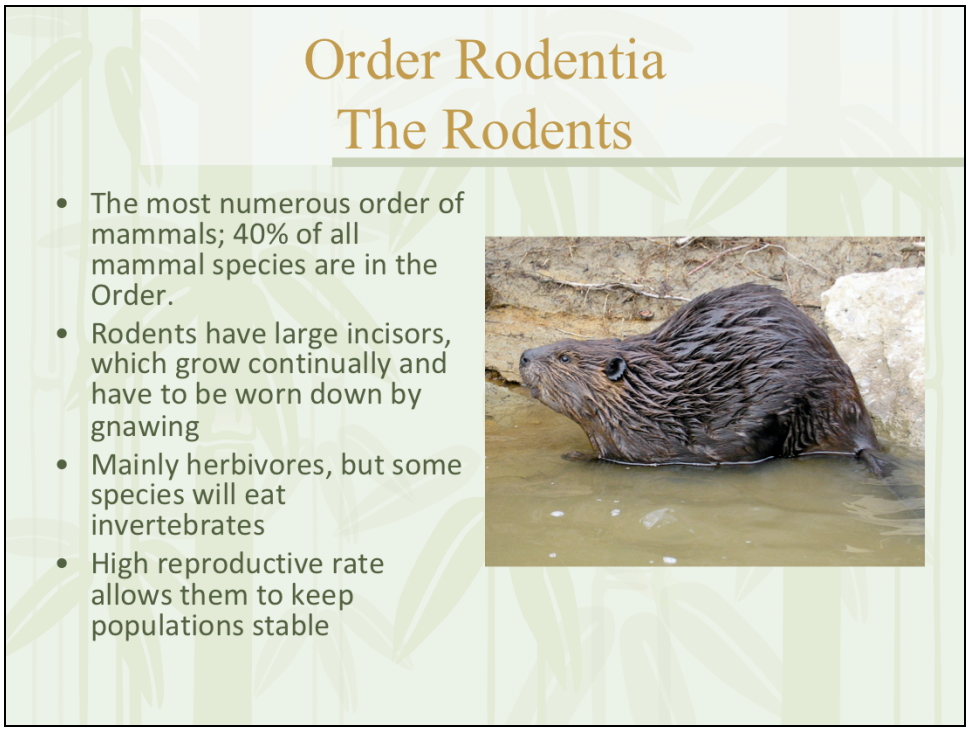


Pilosa means “hairy”. The Order Pilosa, includes the anteaters and sloths. The anteaters do not have teeth and the sloths lack incisors and canines so they appear to be toothless. Anteaters and sloths are chiefly solitary. They can be found in Central and South American.

The anteaters and sloths are very different from each other and are highly specialized. Their vertebrae have secondary and sometimes even more articulations between the vertebrae of the lumbar region. In addition, the pelvis connects with more of the spine than in other mammals, which gives support, particularly to the hips. These articulations provide a large amount of stability to the pelvic region and are thought to be adaptations for burrowing and digging.

Anteaters and sloths both have large, curved claws and powerful forelimbs. The sloth has evolved to use these traits climbing through trees. The sloth’s upside down lifestyle avoids the energy needed for balance when moving along the tree branches.

The Zoo has a two-toed sloth and a giant anteater.



The **Order Rodentia** is the most numerous order of mammals; about 40% of all mammal species are classified as rodents. Most rodents are small animals with robust bodies, short limbs, and long tails. The majority of species are herbivores, but some species will eat invertebrates. Rats and mice are considered omnivores.

Rodents large, razor sharp incisors (2 upper, 2 lower) continue to grow throughout their lives. They are automatically worn down by gnawing. The enamel is found on the anterior surface of these incisors in contrast to Lagomorphs where the enamel extends around to the posterior surface of the tooth.

Rodents are highly successful because they are extremely adaptable. They can live in many different types of habitats and occupy a variety of niches. Their high reproductive rate allows them to keep populations stable.

The Zoo's rodents include mice, guinea pigs, prairie dogs, and agoutis.

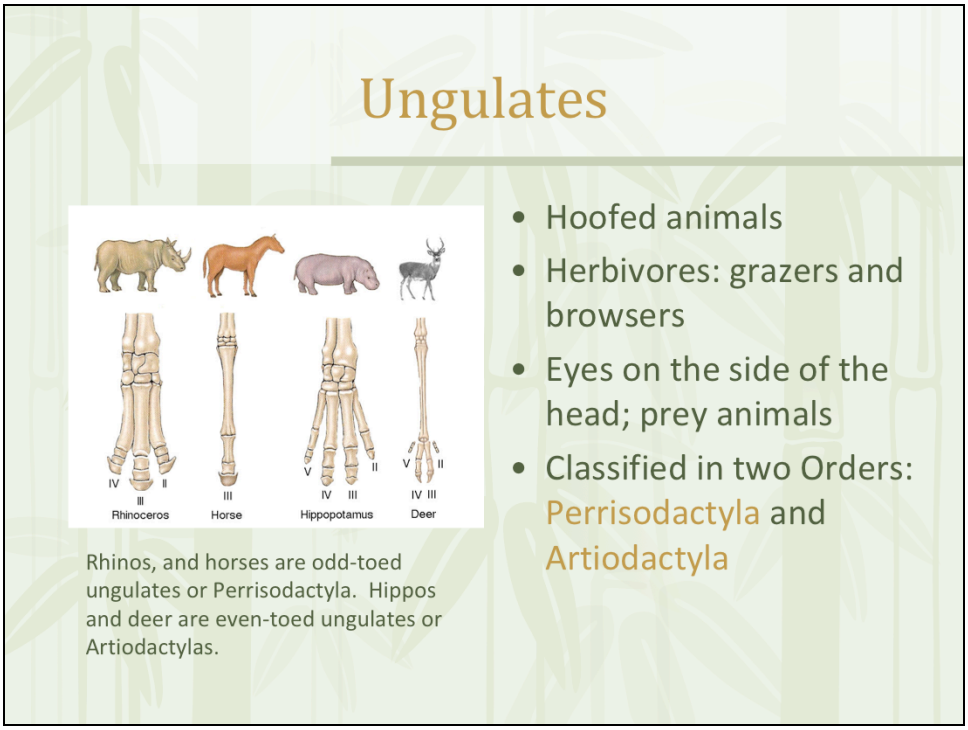
Many think rabbits are rodents, but they are their own Order, **Lagomorpha**. Lagomorphs are distinguishable from rodents in that they have two pairs of upper incisors (the second pair, located immediately behind the larger incisors, are small and peg shaped, often referred to as the "peg teeth"); rodents have one pair of incisors. The front teeth of Lagomorphs and the rodents are chisel shaped and grow throughout their life. The layer of enamel on the upper incisors of Lagomorphs extends around to the posterior surface of the tooth (in contrast to rodent incisors, which have enamel on only the anterior surface.

Lagomorphs are successful because they are extremely adaptable. They can live in many different types of habitats and occupy a variety of niches that include: arboreal, terrestrial, **fossorial** (burrowing), and semi aquatic. All are herbivorous. They are opportunistic feeders with a wide ranging diet. They are found almost worldwide.

Lagomorphs have high reproductive rates. Rabbits are the most prolific breeders and can have up to 6 litters of 12 young annually. They are **induced ovulators**, meaning that the act of breeding causes the female's ovaries to release eggs.

Rabbits and hares have elongated ear pinnae for improved hearing. Species in warmer clients have longer ears for heat evaporation while those in cooler climates have reduced ears to help maintain their body temperatures. Their rear legs are adapted for jumping. The hare is generally larger and faster than rabbits and has longer ears and larger feet.

The Zoo has rabbits in the Exploration Zone. The Sculpture Learning Plaza has an Arctic hare.



Ungulates are a diverse group of large mammals, most of which use the tips of their toes, usually hoofed, to sustain their whole body weight while moving. They account for the vast majority of large herbivores. Some like the zebras and horses are **grazers**. Molars of grazers are large and flattened, with a series of ridges to help grind up the plant material. Others like the black rhino and hippo are **browsers**. Browser molars are also large and flattened but tend to be identified by a series of peaks and valleys to help crush and grind the more fibrous plant material. **Note:** The greater one-horned or Indian rhino is both a grazer and a browser. It likes tall grasses, but also consumes leaves, branches and submerged aquatic plants.

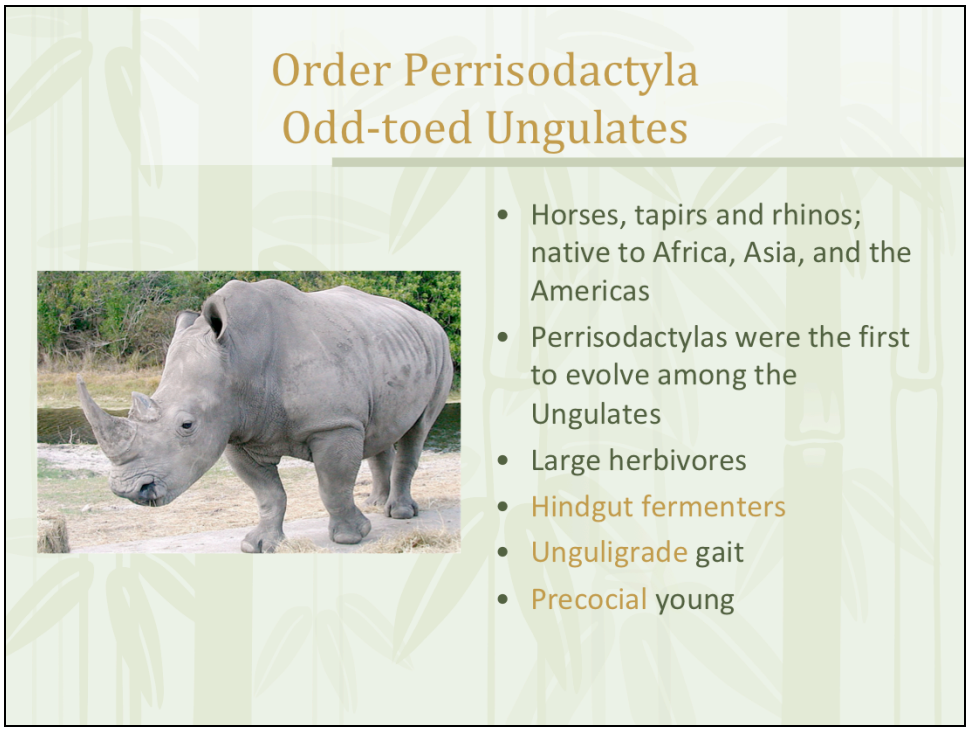
The diversity of these herbivores was also successful because different species began to rely on different parts of the plant(s); they each had distinct diets and separate niches. For example the zebras like the course older tips of the grass, whereas the wildebeast, preferred the more tender center part of the grass blade. They also may move over long distances to take advantage of the growth phases of grass in different regions in order to find enough food. (i.e. zebras, eland, and wildebeast are part of the great migration of Africa, the largest terrestrial migration of mammals in the world)

Ungulates are prey animals with eyes on the side of their head, which provides for more extensive range of vision and thus greater vigilance when trying to spot predators.

Ungulates developed hooves instead of claws and are classified into two different Mammalian Orders based on the number of toes. 60 million years ago, the two Orders (Perrissodactyla and Artiodactyla) diverged from a common hoofed ancestor. The **Perrisodactyla** are the odd-toed ungulates (i.e. rhino, horse, tapir). The middle toe is larger than the others and weight bearing runs through the middle digit, digit III of each foot. They were the first to evolve and were the dominant large herbivores early in evolutionary time.

The **Artiodactyla** are the even-toed ungulates (i.e. giraffe, hippo, sheep, goats, camels, pigs, peccaries, cows, deer, and antelopes). The third and fourth digits, remain large and bear weight in all artiodactyls. As grasses evolved, so did the Artiodactyla and were better able to adapt to coarse, low-nutrition diets, (through rumination) and soon rose to prominence over the Perissodactylas.

The Order **Cetacea** (whales and dolphins) is sometimes merged with the Artiodactyla forming new Order **Cetartiodactyla.** This new Order reflects the idea that whales evolved with the Artiodactyla with the hippo being their closest relative. The Order Cetartiodactyla hasn't been fully accepted by the scientific world.



The Order **Perrissodactyla** contains hoofed mammals with an odd number of toes on their rear foot. They have an **unguligrade** gait; they walk on hooves, which is a specialization in running animals. This Order includes horses, zebras, tapirs and rhinos.

Odd-toed ungluates are large herbivores with simple stomachs, digesting grasses and plant cellulose in the intestines (**hindgut fermentation**). With hindgut fermentation, microorganisms that help break down cellulose are housed after the stomach in the intestines. Since most absorption of the nutrients occurs in the small intestines and food is still being digested there, this process is inefficient. The large hind-gut fermenters are bulk feeders; they ingest large quantities of low-nutrient food.

The Perissodactylas bear well-developed (**precocial**) young, usually a single offspring, which is able to walk shortly after birth.

The Zoo has a black rhino, a greater one-horned rhino, zebras, donkeys and a horse.

Note on the digestive system: The digestive tract breaks the food down into smaller parts. Food and water enter the stomach where it mixes with digestive juices and then enters the small intestine. The small intestine absorbs water and digested nutrients into your bloodstream. After the small intestine, the large intestine makes the waste products into a stool, which is excreted from the rectum. More nutrients and water can be absorbed in the cecum of the large intestine but the majority occurs in the small intestine. Mammals lack the enzymes needed to breakdown the cellulose of plant walls and thus can only access a small portion of the nutrients in vegetation by themselves. Mammals are aided in cellulose digestion by microorganisms residing in the digestive system, either in the stomach (**foregut fermentation**) or in the intestines (**hindgut fermentation**). Rumination is a process using foregut fermentation.

Artiodactylas are a hoofed animal with an even number of toes on each foot. The even-toed ungulates have come into their prime only in recent times, surpassing the odd-toed ungulates in numbers. They are distributed worldwide and include antelope and cows, pigs, peccary, hippos, sheep, goats, camels, deer, pronghorn and giraffe.

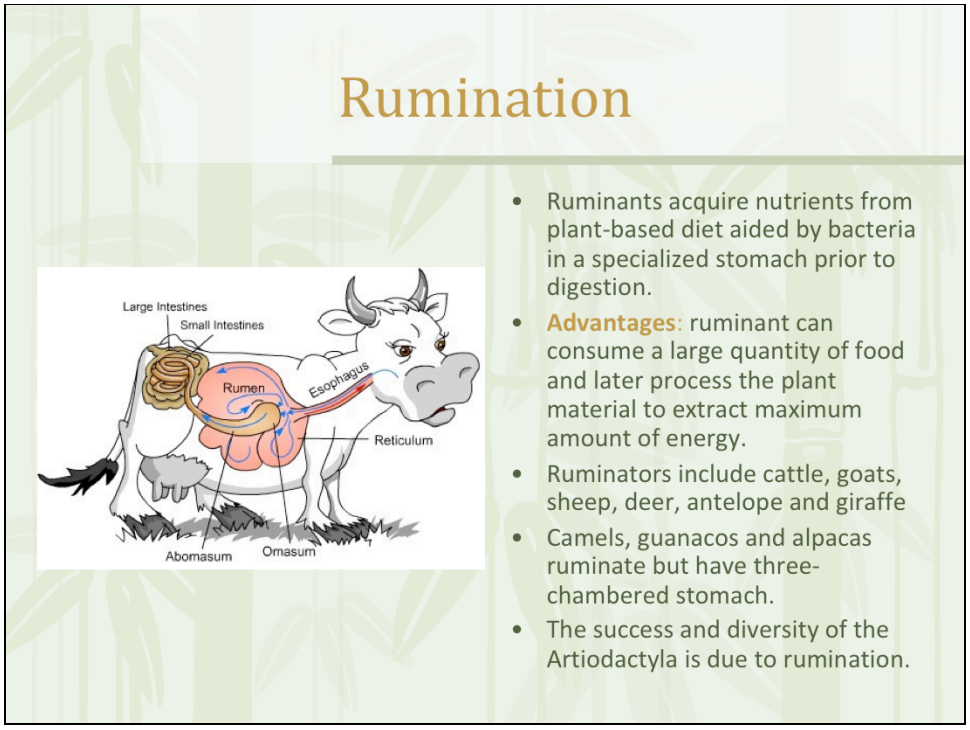
They are mainly **ruminants** or "cud chewers", with four-chambered stomachs and **foregut fermentation** by microorganisms. Ruminants include deer, giraffe, antelope, sheep, goats, buffalo, and cattle. Other Artiodactylas include the pig and peccary whose stomachs are two chambered and are non-ruminating. In the hippopotamus, the stomach is three chambered and they are non-ruminating. Camels, llamas, guanacos, alpacas, and vicunas have a three-chambered stomach and are ruminating.

Artiodactyla, typically, have one or two **precocial** offspring, except pigs which have litters. Why are precocial young an important adaptation in the ungulates?

Most Artiodactyla are herd or group animals, and all have skin glands. Scent glands of certain mammals secrete an often oily material of distinctive odor. Scent plays a major role in many species including marking territory, cohesion of the group and attracting mates. Urine and feces are used as well as glandular marking among certain species. Tree marking and rubbing are practiced by the deer family and the cattle, sheep, goats, and antelope family.

Scents are an important part in communication; scents mark territories and reflect sexual fertility. The **Flehmen response** is a behavior whereby an animal curls back its upper lips exposing its front teeth, inhales with the nostrils usually closed and then often holds this position for several seconds. The behavior facilitates the transfer of **pheromones** and other scents into the **vomeronasal organ (VMO or Jacobson organ)** located above the roof of the mouth via a duct which exits just behind the front teeth of the animal. **Note:** scents are also very important in the cat Family and also exhibit the Flehmen response.

The Zoo has many examples of even-toed ungulates: Chacoan peccary, hippo, alpaca, guanaco, giraffe, several antelope species and sheep and goats.



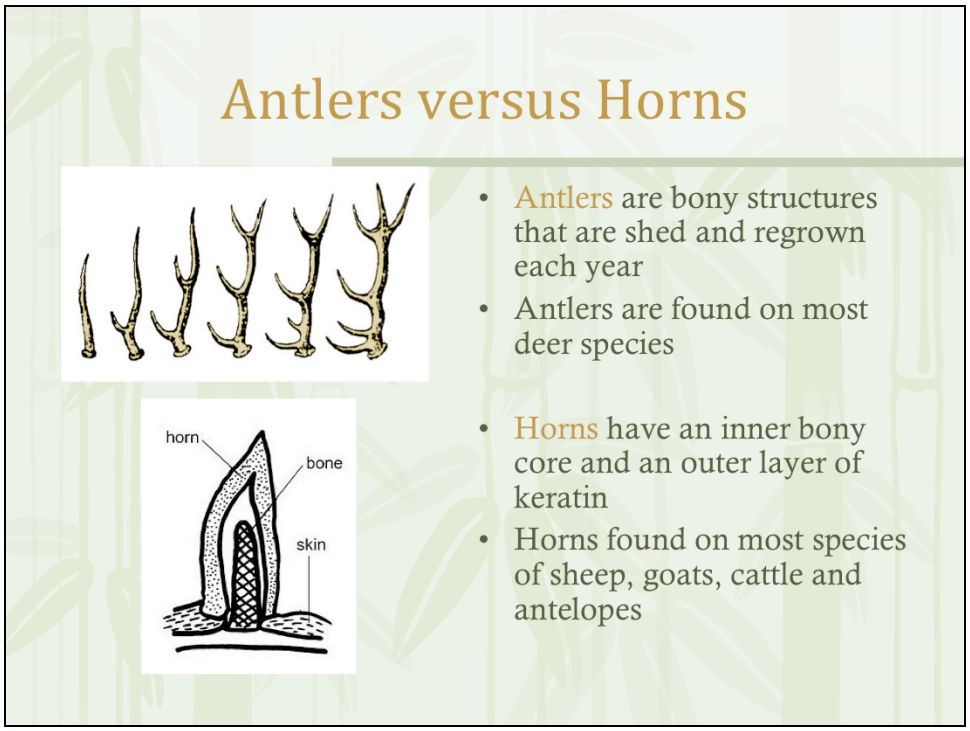
From the Miocene onwards, grasses covered the plains and provided a new food source. Rumination provided a faster, more efficient method of extracting greater nutrition from low quality vegetation. In ruminants, microorganisms that help digest cellulose are housed in the stomach and the extracted nutrients can be absorbed the full length of the intestines (**foregut fermentation**). **Note:** In hindgut fermentation, since the microorganisms are located mostly in the cecum of the large intestine, the animal doesn't have the full length of the intestines for absorption of the extracted nutrients.

The stomach of ruminants consists of four chambers—each playing different roles in the digestion process. Ruminants gather food, chew it briefly, add saliva and swallow, sending it to the first stomach chamber. Later when the animal is resting safely, without fear of predators, the semi-digested "cud" is regurgitated, re-chewed and further mixed with salivary juices. The food is swallowed for a second time and progresses through the other stomach chambers where it is broken down further before entering the intestines. In this way, the animal is able to extract the maximum possible food value. Cud chewers are able to quickly consume a large quantity of low-grade food, and later put it through the grinding and chemical process necessary to convert it to energy.

There are non-ungulate animals that also have foregut fermentation. For example, the kangaroo and colobus monkey have a two-chambered stomach and the sloth has a three-chambered stomach for digestion but all are ruminant-like and not true ruminators.

How does foregut fermentation differ from hindgut fermentation? In **hindgut fermentation**, the digestive process relies on microorganisms that are mainly in the enlarged cecum of the large intestine. This is not as efficient, since nutrients are absorbed into the bloodstream mainly from the small intestines. To make up for this inefficiency in hindgut fermentation, these species must eat larger quantities of food. In **foregut fermentation**, the food is already broken down when it reaches the intestines. Absorption of nutrients can occur along the entire intestines.

Note: Carbon dioxide and methane gas are byproducts of foregut fermentation. Increased levels of these gasses trap heat in the lower levels of the atmosphere resulting in global warming.



Antlers are extensions of the skull grown by members of the deer family. They are boney structures that usually grow in symmetrical pairs. In most species, only males grow antlers, which are used in combats between males for dominance and as sexual displays when competing for females. Antlers are shed annually at the end of the mating season and regrown starting in the spring. The exception is that female caribou and reindeer have antlers but retain them longer than the males to help protect their young. **Velvet** covers a growing antler and provides it with blood, supplying oxygen and nutrients. Once the antler has achieved its full size, the velvet is lost and the antler's bone dies. This dead bone structure is the mature antler.

Horns are found on the heads of most ruminant species including cattle, sheep, antelopes, giraffe and goats. A horn has an inner bony core and the outer sheath, which is made of keratin. Horns are permanent, ever-growing, and do not regenerate if injured. In species where both sexes have horns, the males are generally larger (i.e. yellow-backed duikers, African Cape buffalo and wildebeest). Horns on males are thicker at the base and able to withstand more force and are also used for dominance and sexual displays. In addition, horns may be used to root in the soil or strip bark from trees.

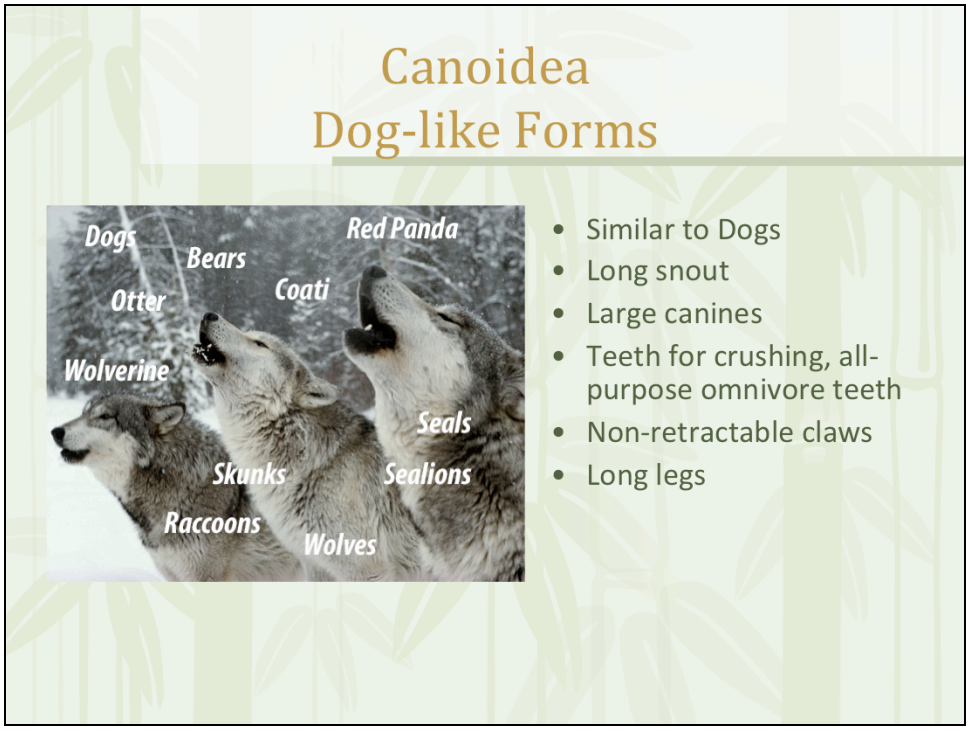
A **giraffe** is born with a cartilaginous horn that calcifies after birth. These **ossicones** are permanent, and remain covered with skin and fur. Why do giraffes have horns? In fighting for dominance male giraffes joust by “necking”, they wrap their necks around each other and banging their heads together. This would explain the extra bony protuberances that grow on the males. The horns are thought to be originally support structures for the antlers that their ancestors had.

A **rhinoceros** horn is composed of solid keratin fibers and is regenerated by continuous growth. A rhino horn has been used in traditional Chines medicine and costs as much or more than gold on the black market. During the 1970s and 1980s in Yemen, rhino horn was used for carving traditional dagger handles. Proper legislation has banned this practice and with a public awareness campaign has virtually eradicated this practice.

The Order **Carnivora** does not include all meat-eating mammals and not all members of the Order Carnivora are true carnivores. The Order name comes from their ancestry and the first carnivoran was a carnivore. Today, carnivorans are mainly meat-eaters, but some are omnivores and a few are herbivores. Species in this Order share long canines and specialized molars called **carnassial teeth**, which have a cutting edge that act like scissors against each other. The length of the carnassials is determined by the size of the animal, how much its diet is carnivorous and the size of the chunks of meat it can swallow. Bears and pinnipeds (seals, sea lions, and walruses) carnassial teeth are not well developed. Carnivorans have simple stomachs and undeveloped cecums as meat is easy to digest.

Most characteristics of Carnivorans involve adaptations for pursuing & consuming prey. Most have acute vision with forward facing eyes and a well developed sense of smell and acute hearing. Forward facing eyes provide **binocular vision**, which helps with determining depth of field and an increase in judgment in capturing prey. To compensate for the reduction of visual range, carnivores have mobile eyes and mobile necks. Cats are mostly **nocturnal**; they have relatively large eyes and on the back of the retina they have a high reflective layer called the **tapetum lucidium**; this layer allows for increased vision in low light. When light strikes a cat's eyes at night, this layer reflects the light causing the eyes to glow.

Carnivoran species tend to lead solitary lives and may not come across a mate frequently, so delayed implantation allows these species to carefully time birthing and/or weaning when food is most abundant. **Delayed implantation** is when the embryo does not immediately implant in the uterus, but it is maintained in a state or dormancy. Bears usually mate when they first come out of their dens in the spring and the egg will only implant if the mother has found sufficient food before she dens up. In this way, she can time her emergence from the den with the weaning of the cubs when food resources are plentiful. In the case of the seals, they come ashore to give birth and molt. Delayed implantation may serve to enable seals to combine birth and mating into a single period and avoid potentially dangerous period spent ashore. **Induced ovulation** is when the females release an egg during or shortly after copulation. This strategy allows females to be receptive to a mate when they cross paths.



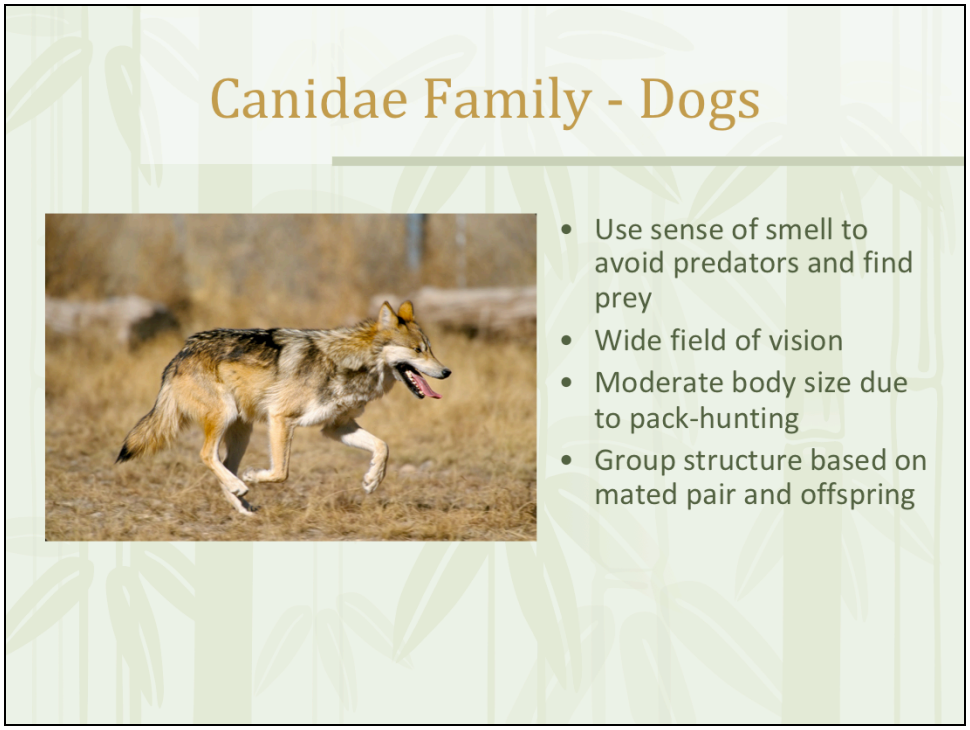
The **Carnivora** Order split early in the evolution process into the dog-like and cat-like forms about 50 million years ago. The split began with a change in dentition; the cat-like forms became more highly specialized predators.

The **Canoidea** or dog-like forms typically possess a long snout and non-retractile claws. They tend to more terrestrial and and use their sense of smell to avoid predators and to find prey. Many hunt in packs and are social animals, giving them an advantage over larger prey. Their teeth are designed for crushing and their diet is more all-purpose omnivore diet of meat, insects and plants. Dog-like forms maintained the flat grinding molars of their herbivore ancestry. (i.e. The grizzly bear's diet is 90% vegetation)

Dogs and wolves are **digitigrade** animals (they walk on their toes) whereas the bears are **plantigrade** (walking on their soles with the heels touching the ground.

Carnivoran dog-like Families include: **Canidae** (dogs, wolves, jackels, foxes), **Ursidae** (bears, giant panda), **Procyonidae** (raccoons, coatimundi), **Ailuridae** (red panda), **Mustelidae** (otter, wolverine, weasels and badgers), **Mephitidae** (skunks - Note: formerly of Mustelidae Family), and the **Pinnipeds** which are considered a clade and have specialized adaptations to aquatic life**.** There are three families of Pinnipeds: **Phocidae** (earless seals, true seals), **Otariidae** (eared seals, sealions), and **Odobenidae** (walrus). The pinnipeds have specialized adaptations to aquatic life.

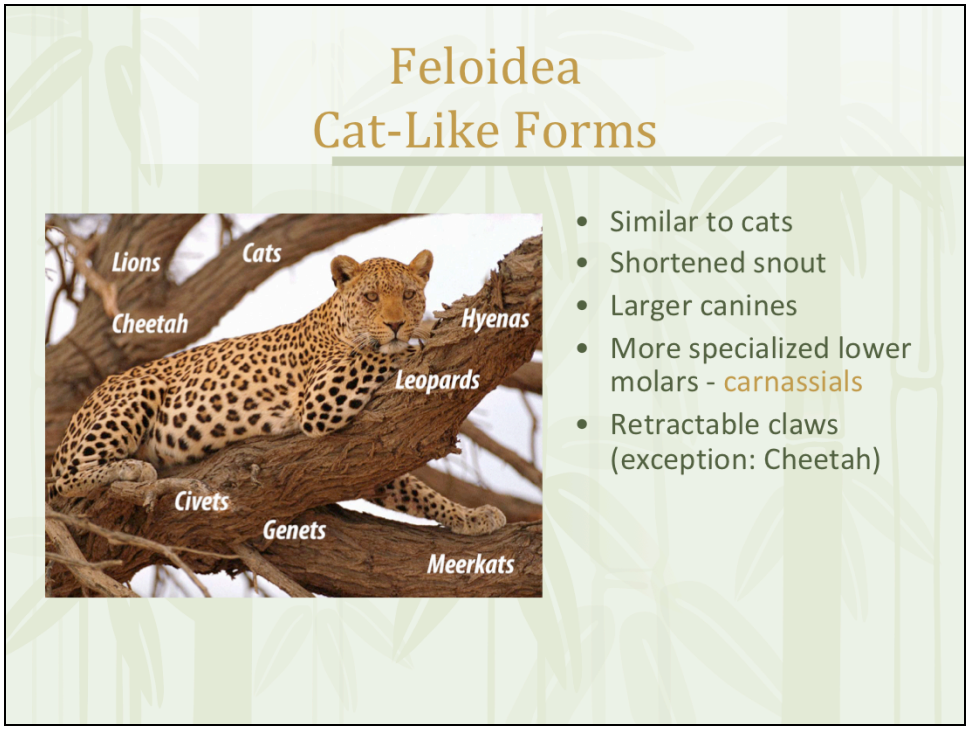
The Zoo's dog-like Carnivorans include: red panda, South American coatimundi, black & grizzly bear, North American river otter, wolverine, and California sea lion. The Sculpture Learning Plaza has an Ethiopian wolf.



Canids are more omnivorous than many carnivores, taking as food invertebrates, plant matter, and carrion as well as the prey they kill themselves. They are adapted more for endurance than for speed, and they catch prey by pursuit over long distances in relatively open terrain until the prey tires. Kills are made by grabbing for the nape of neck and tackling the prey to the ground.

Canids have a wider field of vision than the felids. Dogs can smell at least 4x better than cats based on the number of olfactory receptors.

Some species (generally ones with larger body sizes i.e. wolves) form packs with strict social hierarchies and mating systems. Hunting in packs allows canids to capture species much larger than themselves.



The **Feloidea** or cat-like forms typically possess a shortened snout and retractable claws. The canines are larger than the dog-like form and there is a gap behind the canine, so that the teeth can sink all the way to their gums when making a kill. These cat-like forms tend to have have fewer teeth and more specialized carnassials, used for shearing flesh. They tend to be more carnivorous and generally ambush hunters who eat by grabbing and tearing. They tend to be more **digitigrade** and many are arboreal or semi-arboreal.

Cat-like forms includes the Families: **Felidae** (cats, tiger, lion), **Viverridea** (civets & genets), **Herpestidae** (meerkats, mongooses, fossa), **Hyaenidae** (hyenas).

The Zoo's cat-like Carnivorans include: meerkat, fishing cat, snow leopard, Sumatran and Siberian or Amur tigers, African lion, and a bobcat.

Cats are highly specialized predators. They have a very flexible spine, (they have more thoracic and lumbar vertebrae than humans) which allows the cat greater agility when chasing down prey. The front paws are for capturing and grasping prey; they are able to rotate and bring the soles of their front paws together. They have large paws with retractable claws and soft footpads that allow them to silently stalk its prey. A cat's tail is important for balancing the weight of the body especially when they are pursuing prey. **Note:** Cheetahs do not have retractable claws. **Also Note:** Cats are know for their silent, stealth movements and hence the term "cat burglar".

A typical cat has a sleek body with a rounded head and a small muzzle. Coat colors and patterns vary from species to species and serve the purpose to conceal the animal from detection.

Cats have large, forward facing eyes with **binocular vision**; they also have a wide range of **peripheral vision**, which is good at detecting motion. The felids have the largest eyes of the Carnivorans and have better visual acuity at close ranges than the canids. They use their sense of smell to examining things up close. They are able to see in the dark due to a tissue (**tapetum lucidium**) that reflects light back through the retina, allowing cats to see better in the dark. This gives cats their characteristic "eye shine". Cats have a good sense of smell, but not as developed as other Carnivora Families such as the bears. When hunting, a cat depends more on sight and hearing than on smell. Cats have thick whiskers that allow them to feel things that they may not see, especially at night when hunting.

Cats have highly specialized teeth and a short digestive tract suitable to the digestion of meat. Cats (Family Felidae) are **obligate carnivores**; their nutritional needs are met by only eating meat. Cat tongues are rough due to small bumps (**papillae)**. These are good for scraping meat off bones and they help hold water on the cat's tongue as they drink. A cat also grooms itself with its tongue, which acts as a comb to brush the fur.

Cats are divided into large and small cats; the differentiation is the **hyoid bone**, which connects the tongue to the roof of the mouth. In big cats the hyoid has an elastic segment, while that of small cats is hard all over. The hyoid bone allows big cats to produce a roar and prevents them from purring in the same manner as small cats. "Big Cats" are of the genus *Panthera* and *Neofelis, which include* tiger, lion, jaguar, and leopards. **Note:** some "Small Cats" are actually larger than some "Big Cats". (i.e. the mountain lion is a big "Small Cat"). **Also Note:** the snow leopard has a hyoid bone and is in the genus *Panthera*, but it does not roar.

The three Orders, Rodentia, Chiroptera (bats) and Eulipotyphla (mole, shrew, hedgehog) comprise over 70% of all mammal species. Some of the other Mammalian Orders include:

The Order Cetacea (whales, dolphin) is now sometimes combined with the Order Artiodactyla, forming a new Order Cetartiodactyla based on the evolution history of these two groups. The Sculpture Learning Plaza has a gray whale.

Order Chiroptera (bat) The Sculpture Learning Plaza has an Indian flying fox.

The Order Insectivora is now broken into the Afrosoricida (tenrecs, golden moles) and Eulipotyphla (hedgehogs, moles, shrew moles, true shrews) The Sculpture Learning Plaza has a star-nosed mole.

Order Cingulata (armadillo)

Order Scandentia (tree shrews)

Order Dermoptera (colugos or flying lemurs)

Order Macroscelidea (elephant shrews)

Order Pholidota (the pangolin) The Sculpture Learning Plaza has a pangolin.

Order Proboscidea (elephants)

Order Sirenia (sea cows, manatees)

Order Tubulidentata (aardvarks)

Order Hyracoidea (hyraxes)

Note: Be aware of these other mammalian Orders. There is no need to memorize them.

Mammals both large and small are being threatened due to habitat loss and being hunted for **bushmeat**, trophies, consumer products, traditional Chinese medicine and to get rid of nuisance animals.

Getting the Zoo community more involved with mammal conservation is key to success and your responsibility as a docent. Individuals can play a huge role in championing species conservation efforts, and ultimately this can lead to site-level protection programs. The Zoo is involved in many SSP projects to help save these species. Docents are key to interacting with the visitors and helping them to connect, care and conserve.

The Zoo is helping in the conservation of mammals through species survival plans (SSP). There are a few examples of these SSPs below.

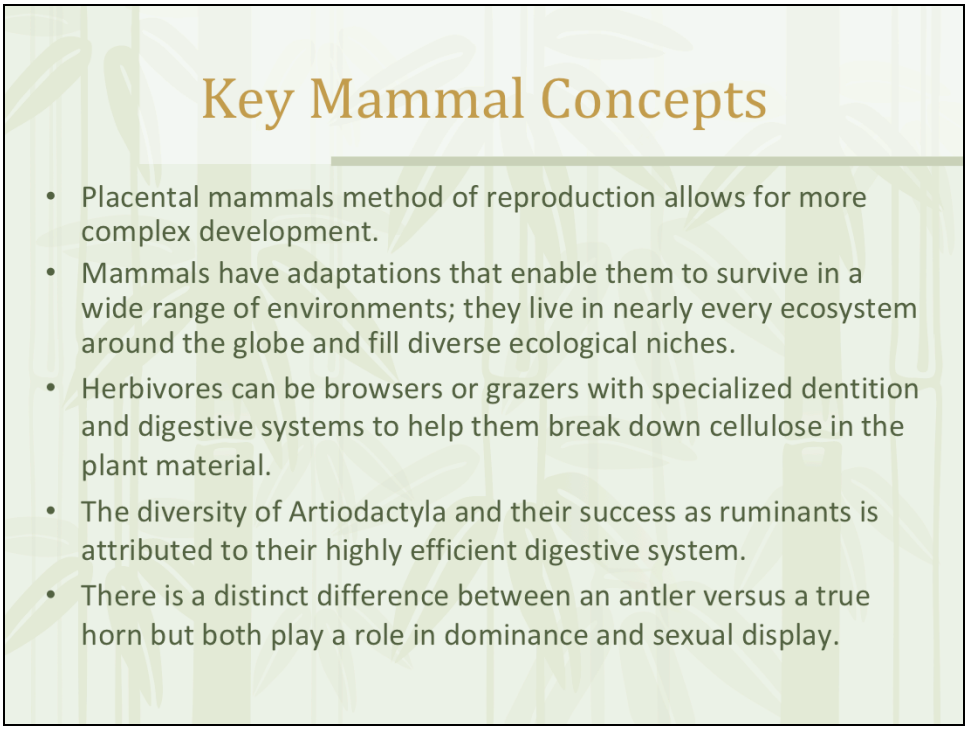
By the 1970s, the Mexican gray wolf population all but disappeared from the wild. Three federal agencies oversee the program, in which zoos and nature centers raise wolves that can later be released into the wild. As part of the Mexican gray wolf SSP, the San Francisco Zoo now exhibit three brothers. The brothers probably won't be released back to the wild because of their age. Instead, scientists will take sperm from them to breed future pups.

The Chacoan peccary is an endangered species found only in a small, endangered habitat. The SSP helps to manage the breeding and transfer of Chacoan peccaries within accredited institutions, such as the Zoo, for the health and welfare of the species and to work to keep Chacoan peccaries from extinction.

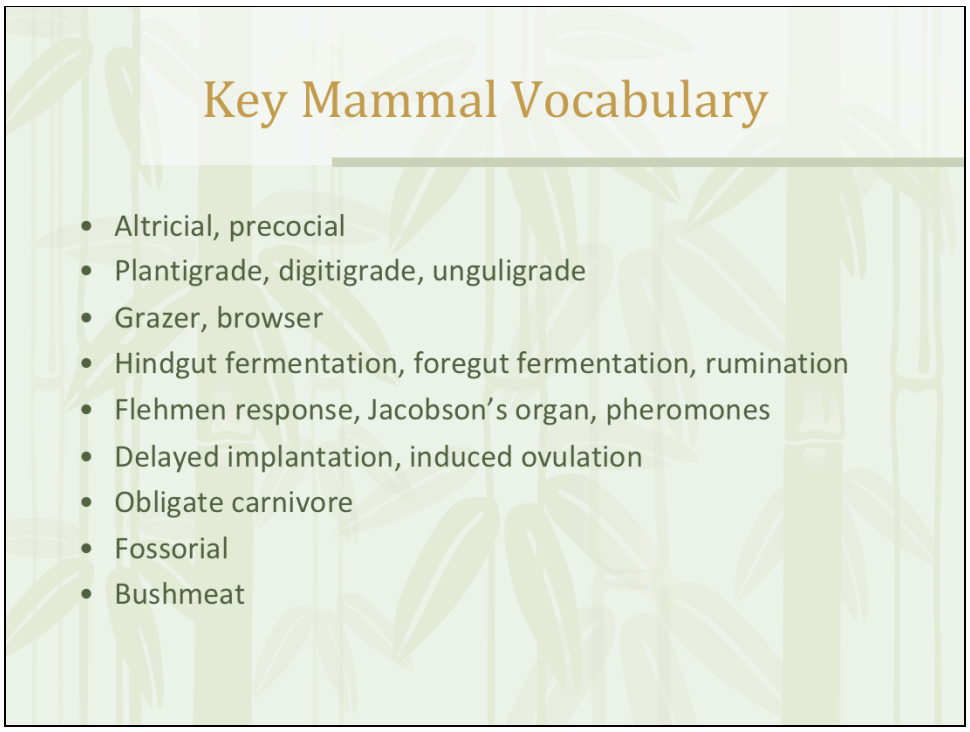
The Zoo's Conservation Partnership Program aims to develop a small number of long-term partnerships with other conservation organizations that will draw on the Zoo's intellectual resources. The Gorongosa Lion Project in Gorongosa National Park, Mozambique provides critical support for the protection of lions and other wildlife in a newly revitalized park following years of political turmoil and war.

Although the California sea lion is listed as Least Concern on the IUCN Red List, both of our sea lions are blinded from injury and disease in the wild and no longer able to survive on their own. They were rescued by The Marine Mammal Center and found a second chance at life here at the San Francisco Zoo. They serve as a success story and can be used to talk about marine mammals.

Note: refer to the Conservation training unit for more information on conservation.



Corresponds with the Mammalia, Artiodactyla, Carnivora, Rodentia/Lagomorpha, Perrisodactyla, Pinnipedia, and Xenarthra Study Guides. For specifics on the zoo's mammal collection read the Fact Sheets in the Docent Notebook on the Mammalian Orders: Pilosa (formerly Xenarthra), Lagomorpha, Rodentia, Carnivora, Perrisodactyla, and Artiodactyla. Also go to the SF Zoo's website (sfzoo.org)



Definition:

Atricial: helpless at birth or hatching and requiring parental care for a period of time

Browser: type of feeding where an animal eats the vegetation on bushes and trees

Bushmeat: wild animals hunted for human consumption.

Carnassials: modified fourth upper premolar and the first lower molar, found in the Order Carnivora, used for shearing flesh and bone in a scissor- or shear-like way.

Delayed implantation: delayed implantation the embryo does not immediately implant in the uterus, but it is maintained in a state or dormancy. Examples include rodents, bears, seals.

Digitigrade: walking or standing on its digits, or toes such as a walking bird, cats, or dogs. Digitigrades generally move more quickly and quietly than other animals.

Flehmen response: is a behavior whereby an animal curls back its upper lips exposing its front teeth, inhales with the nostrils usually closed and then often holds this position for several seconds. The behavior facilitates the transfer of pheromones and other scents into the **Jacobson's organ** located above the roof of the mouth via a duct which exits just behind the front teeth of the animal. This behavior is seen in ungulates and felids (the cats).

Fossorial: one that is adapted to digging and life underground.

Foregut fermentation: cellulose digestion seen in ruminants and rely on large complex stomach with rumen

Grazer: type of feeding where an animal eats the grass on the ground.

Hindgut fermentation: digestive process that relies on enlarged cecum and large intestine

Induced ovulation: the act of breeding causes the female's ovaries to release eggs

Jacobson's organ (VMO or **Vomeronasal organ)**: an organ of chemoreception that is part of the olfactory system of amphibians, reptiles, and mammals. It works by sensing the chemicals such as pheromones.

Obligate carnivore: an animal that by its genetic makeup must eat the tissue of other animals in order to thrive.

Pheromones: a chemical substance released by an animal that serves to influence the physiology or behavior of other members of the same species.

Plantigrade: walking with the entire sole of the foot on the ground, as humans, bears, raccoons, and rabbits

Precocial: refers to species in which the young are relatively mature and mobile from the moment of birth or hatching.

Rumination: the process of re-chewing the cud, which facilitates the proper breakdown of the cellulose rich plant matter.

Tapetum lucidium: reflective layer at the back of the retina helps nocturnal animals see in the dark

Unguligrade: walking on the tips of ones toes, usually hoofed, to sustain their whole body weight while moving; flatfooted.