

EDUCATOR'S GUIDE

THE JILL AND LEWIS BERNARD FAMILY
HALL OF NORTH
AMERICAN MAMMALS

Featuring

Carnivorans



INSIDE:

- Suggestions to Help You **Come Prepared**
- **Essential Questions** for Student Inquiry
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amnh.org/namammals

Essential QUESTIONS

More than 25 Museum expeditions across this continent produced the specimens displayed in this hall's magnificent dioramas. Many belong to the order of mammals called Carnivora (carnivorans), one of the most diverse orders within the mammal group. Use the Essential Questions below to connect the dioramas to your curriculum.

What is a mammal?

You might have grown up thinking that all mammals share certain traits, like fur and giving birth to live young, and most living mammals do. But what defines this diverse group of animals is that they all are descended from a common ancestor shared with no other living animals. Because of this common ancestor (and unlike other **vertebrates**), all mammals have three middle ear bones. The group is divided into over 20 **orders**, which include Primates (e.g. humans), Rodentia (e.g. squirrels and voles), Artiodactyla (e.g. moose and bison), and Carnivora (e.g. dogs and cats).

What is a carnivoran?

While you might think that Carnivora means "meat-eater," this isn't true! The ecological term for a meat-eating animal is **carnivore**, which is a bit confusing. But while most **carnivorans** eat mainly meat, Carnivora is one of the major orders of **placental** mammals and one of the most diverse. Some carnivorans eat both meat and plants—and a few, like the giant panda, subsist almost entirely on plants. Carnivora is divided into two main groups based on relationships. The **Feliformia** are typically "cat-like" and include cats, hyenas, and mongooses, while **Caniformia** are the more "dog-like" species, such as bears, badgers, and skunks. There are over 270 living species of carnivorans, ranging in size from the 50-gram (1.5 ounce) least weasel to the southern elephant seal, which can weigh up to 4,000 kilograms (8,800 pounds). Carnivorans do just about everything that other mammals do except fly. They live in water (seals), form complex social groups (wolves), climb trees (raccoons), and can be found in a every kind of habitat, from **tundra** to **desert**.

How do carnivorans differ from other mammals?

Because they share a common ancestor, carnivorans all share particular traits that are found in no other groups of mammals, such as certain features of bones in the limbs and ear region, and—most importantly—special, bladelike teeth called **caninassials**. When carnivorans bite, these elongated blades shear past each other, slicing like scissors. This ability to shred meat allows them to digest their food more easily. Some carnivorans retain complicated molars, allowing them to grind food like seeds or plants, while others have no teeth behind their caninassials. Despite their shared characteristics, carnivorans can look radically different from each other.

How have traits of the Carnivora helped the order survive and diversify?

As environments change over time, living things must respond by migrating, adapting, or sometimes going extinct. Different traits are favored in different habitats and are passed on to future generations. For example, carnivorans take care of their young until they are old enough to hunt, which helps them live to adulthood. Also, the diversity of their teeth has helped carnivorans adapt to more habitats

than other orders of mammals. Primitive carnivorans had teeth with both shearing and grinding surfaces. Over time, the shearing capability was enhanced or reduced in different species. The shear diminished in the fruit-eating kinkajou, for example, while cats evolved teeth specialized for shearing at the expense of their grinding surfaces. This can put animals at a disadvantage when the environment changes.

That's why lions and tigers didn't survive North America's last ice age, unlike bears and wolves, whose teeth allowed them to eat more kinds of food.



kinkajou

How do scientists study carnivorans?

Scientists observe mammals like carnivorans in their environments, and analyze modern and fossil specimens back in the laboratory. They look for differences and similarities in specific features, such as fur color or the shape of bone, that were inherited from a common ancestor. Scientists also extract DNA and compare genetic information across species. This can be combined with **morphological** observations to determine how different Carnivora are related. This helps scientists answer questions about their evolution, such as how members of the order adapted to different environments, how large brains evolved multiple times across different groups, or how body size has changed over time.



Glossary

carnassials: a pair of bladelike teeth that are unique to carnivorans. The last premolar in the upper jaw has an elongated blade, which shears past a similar one on the first lower molar like scissors. Molars typically are the flat, grinding teeth at the back of a mammal's mouth, and premolars are the teeth between them and the pointed canines.

carnivorans: members of a diverse order of placental mammals, the Carnivora. The majority have large, sharp teeth and powerful jaws, and prey on other animals.

carnivore: an ecological term for any meat-eating animal, including non-carnivorans such as dolphins and non-mammals such as crocodiles.

Caniformia: one of two major sub-groups – the more “dog-like” – in the order Carnivora. Caniformia include bears, dogs, raccoons, seals, sea lions, skunks, walruses, and weasels.

desert: an area with little rainfall. Deserts can be hot, like the Sahara, or cold, like Antarctica.

Feliformia: one of two major sub-groups – the more “cat-like” – in the order Carnivora. Feliformia include cats, civets, hyenas, and mongooses.

morphological: based on physical form, both exterior (shape, color, pattern) and internal (bones and organs). A morphological feature of your hand is that it has five sets of finger bones.

order: a principal category in the classification of organisms, ranking below class (e.g. Mammalia, or mammals) and above family (e.g. Ursidae, or bears)

placental: having a placenta, an organ that nourishes a growing fetus in live-young-bearing mammals. Most modern mammals are placentals.

tundra: a vast, treeless, polar desert

vertebrates: animals that have backbones. This large group contains seven classes, including mammals, birds, reptiles, amphibians, and fishes.

Come Prepared

Plan your visit. For information about reservations, transportation, and lunchrooms, visit amnh.org/education/plan.

Read the Essential Questions in this guide to see how the dioramas in the Hall of North American Mammals connect to your curriculum. Identify the key points that you'd like your students to learn from the exhibition.

Review the Teaching in the Exhibition section of this guide for an advance look at the dioramas that you and your class will be encountering.

Plan how you will use the student worksheets. Designed for use before, during, and after your visit, these activities focus on themes that correlate to the NYS Science Core Curriculum:

- Mammals & Their Features (grades 3-5)
- Mammals & Their Environments (grades 6-8)
- Carnivorans: Similarities & Differences (grades 9-12)

Decide how your students will explore the Hall of North American Mammals. Suggestions include:

- You and your chaperones can facilitate the visit using the **Teaching in the Exhibition** section of this guide.
- Your students can use the **student worksheets** to explore the exhibition on their own or in small groups.
- Students, individually or in groups, can use copies of the **map** to choose their own paths.

Correlations to Standards

Your visit to the Hall of North American Mammals can be correlated to the national standards listed below.

National Science Education Standards

All Grades • A1: Abilities necessary to do scientific inquiry

K-4 • C1: The characteristics of organisms • C3: Organisms and environments • F4: Changes in environments

5-8 • C1: Structure and function in living systems • C3: Regulation and behavior • C4: Populations and ecosystems • C5: Diversity and adaptations of organisms • F2: Populations, resources, and environments

9-12 • C3: Biological evolution • C4: Interdependence of organisms • C6: Behavior of organisms • F2: Population growth • F5: Natural and human-induced hazards

Teaching in the EXHIBITION

As you walk through the Hall of North American Mammals, you'll see breathtaking dioramas that capture every detail of places exactly as they looked when the animals were collected. Most of the mammals in the hall are carnivorans, and we've selected ten of them for the Guided Explorations below.

1 Alaska Brown Bear (*Ursus arctos*)

Family: Ursidae (Caniformia)

Environment: Canoe Bay, Alaska Peninsula

One of the largest living carnivorans, the Alaska Brown Bear's size is related to its rich food supply: abundant salmon in the summer and plentiful vegetable food in the spring and fall. They are omnivorous—they eat both plants and other animals.

GUIDED EXPLORATION: Posture & Food Supply

Encourage students to think about the bears' postures and their food supply. Ask:

- What do you think the bears are looking at?
(Answer: The standing bear is in alert pose. It might have spotted another animal. The bear on all fours is looking at its prey.)
- Think of how a dog or cat stands. How is this bear's posture different?
(Answers: The bear is standing upright, with its hind feet flat on the ground.)
- What feature enables bears to stand upright?
(Answers: Like humans, and the ancestors of carnivorans, bears stand on the whole foot, not on just the toes, like cats and dogs. The larger surface supports their weight better.)
- What is the evidence that their Alaskan habitat can provide abundant food for the bear?
(Answer: Very large animals like bears require many sources of nutrition. The river is most likely a good source of fish, and the surrounding vegetation provides fruits, nuts, and other edible plant material.)



2 Mountain Lion (*Puma concolor*)

Family: Felidae (Feliformia)

Environment: Grand Canyon, Arizona

This large cat is also known as the cougar, puma, or panther. In North America, mountain lions range from Western Canada to Central America. Their chief prey is deer, although they also hunt rabbits, mountain sheep, and domestic livestock. Mountain lions are feliforms (cat-like).

GUIDED EXPLORATION: Physical Form & Hunting Methods

Invite students to compare the mountain lion to another carnivoran, the Alaska brown bear, and explore how they move and what they eat. Ask:

- Look at the body types of the mountain lion and the Alaska brown bear. How are they alike? How are they different? What do their body types suggest about how they move?
(Answers will vary. While there are many differences between the two animals, such as coat color, length of tails, ear shape, etc, make sure the students think about how the mountain lion is much slimmer and seems lighter on its feet.)
- The ranges of these two animals can overlap. Do you think the mountain lion and bear compete for food like deer?
(Answer: It's unlikely. A bear will attack a baby deer, but adults are too swift and agile for the lumbering bears. However, the slim mountain lion routinely succeeds in catching adult deer.)

3 Jaguar (*Panthera onca*)

Family: Felidae (Feliformia)

Environment: Box Canyon, Mexico

Good climbers in spite of their size, jaguars live chiefly in dense rainforests and will attack their prey (mostly large and medium-sized animals) from trees. Mountain lions are more likely to chase their prey over longer distances.

GUIDED EXPLORATION: Physical Form & Hunting Methods

Have students compare the physical features and hunting patterns of the jaguar and the mountain lion. Ask:

- What physical differences do you note in the two big cats?
(Answers will vary. There are many differences, but the jaguar is much more muscular than the mountain lion, which means it is stronger but not as fast.)
- The jaguar and the mountain lion are both ambush predators. How do you think they hunt, and what do you think they eat?
(Answer: Ambush predators hunt by hiding motionless, waiting for the prey to come within striking distance, and then attacking. Both the jaguar and the mountain lion feed on medium-sized animals such as deer.)
- These two big cats can share a habitat. When their ranges overlap, how do you think their hunting patterns might change?
(Answer: When the ranges overlap, the more powerful jaguar is able to hunt larger animals so the mountain lion adapts by eating smaller prey.)



4 Lynx (*Lynx canadensis*)

Family: Felidae (Feliformia)

Environment: Mount Albert, Quebec

The Canada Lynx lives exclusively in northern forests—it is both well adapted to and solely dependent on this type of habitat. This one is hunting a hare, its primary food source, although lynxes will also feed on other small mammals, birds, and even deer and foxes.

GUIDED EXPLORATION : Adaptation to Environment & Food Supply

Invite students to examine the thick fur of the lynx and to explore how it is adapted to its environment. Ask:

- The lynx is closely related to the jaguar and the mountain lion. Look closely at the lynx's fur. How does it compare to the coats of the other big cats you observed?
(Answer: All of these cats have similar fur, but the lynx's fur is relatively longer and denser.)
- How do the lynx's features help it survive in this habitat?
(Answer: The lynx is well adapted to its life on a snowy Canadian mountain. Its soft and thick fur keeps it warm, and its large feet with fur-padded soles form a broad surface for traveling across snow.)
- What do you think the lynx preys on? (Help students find the hare hiding under the bush on the left.)
(Answer: Small animals such as hares, foxes, and birds. The Varying Hare is the main food of the Canada Lynx.)
- How might lynx populations and hare populations be linked? What would happen if the hare population decreased?
(Answer: If the hare population decreases, so does the lynx's, unless these cats can find new sources of food.)
- What other factors do you think might influence the population of the lynx?
(Answers may include: habitat destruction, competition for prey from other predators such as the mountain lion, being hunted by other animals, and the amount of vegetation available for hares to eat.)

5 Wolf (*Canis lupus*)

Family: Canidae (Caniformia)

Environment: Gunflint Lake, Minnesota

The wolf once ranged over most of North America, but as Europeans colonized the continent, they trapped and hunted it to the point of scarcity. Since the bison population has all but disappeared, deer now form an important part of the wolf's diet. Wolves also may eat domesticated livestock.

GUIDED EXPLORATION: Environmental Change

Have students examine the factors that contributed to the decline of the wolf population. Ask:

- How are wolves typically portrayed in stories (e.g. Little Red Riding Hood, Three Little Pigs)?
(Answers may include: Wolves are often portrayed as scary animals that attack and kill. The same features that make wolves such effective predators—large size, strong teeth and jaws, speed, pack behavior, etc.—can be frightening to humans.)
- Humans rarely eat wolf meat. So why do you think humans hunt and kill wolves?
(Answers may include: Humans and wolves often share the same habitat. Humans typically kill wolves to protect their livestock, and may also fear being attacked themselves.)
- The wolf is now scarce in most parts of the United States. Do you think this carnivoran should be protected? Why or why not?
(Answers will vary. Tell students that the wolf is a top predator important in ecosystems and is listed on the U.S. Endangered Species List.)



6 Coyote (*Canis latrans*)

Family: Canidae (Caniformia)

Environment: Yosemite Valley, California

Coyotes are close relatives of wolves but much smaller and more solitary. They eat jack rabbits and rodents like prairie dogs, but will eat larger animals like deer if available.

GUIDED EXPLORATION: Competition for Resources

Have students compare and contrast the coyote and the wolf, and to explore the success of the coyote population. Ask:

- What characteristics do coyotes and wolves share? How do they differ?
(Answers many include: Both mammals are dog-like carnivorans and they look quite alike, although wolves are larger and much more muscular.)
- While both animals chase down their prey, coyotes are more solitary while wolves live and hunt in packs. If the coyote and the wolf share a habitat, how do you think the overlapping range would affect their hunting patterns?
(Answer: Because wolves are larger and hunt in packs, they prey upon larger animals such as deer. Coyotes tend to eat smaller animals such as rabbits and rodents. However, coyotes will hunt deer if there are no wolves to compete with.)
- Unlike wolves, coyotes have increased in number since the 1700s. What do you think might explain this?
(Answer: The coyote is not hunted by humans as much as wolves are. The coyote population also benefits from the absence of its key competitor, the wolf. Also, because the coyote is a solitary animal, its presence can go largely undetected.)

7 Spotted Skunk (*Spilogale putorius*) & Cacomistle (*Bassariscus sumichrasti*)

Family: Mephitidae & Procyonidae (Caniformia)

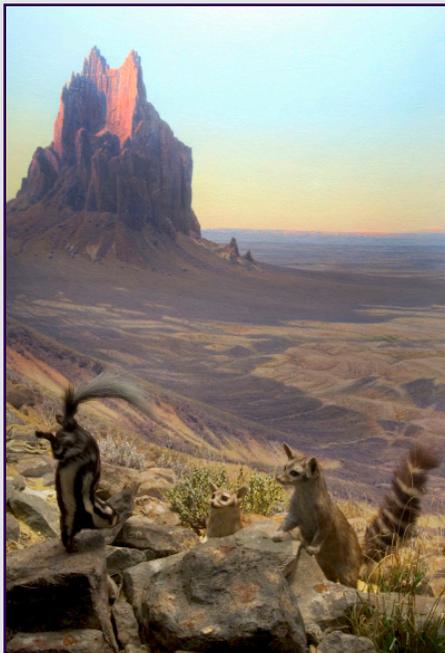
Environment: Ship Rock, New Mexico

Smaller and more active than its more familiar striped relative, the spotted skunk will rear up on its front feet when it feels threatened (as this one is doing) and spray smelly musk oil in the direction of its attacker. The cacomistle, a nocturnal, omnivorous carnivore, is closely related to the raccoon and tends to hunt small mammals such as mice.

GUIDED EXPLORATION: Defensive Behavior

Invite students to explore the relationship between the two mammals in this diorama. Ask:

- What do skunks eat? What about cacomistles?
(Answer: The skunk's diet consists chiefly of insects, but it also preys on birds, their eggs, reptiles, and small mammals. The cacomistle has a similar diet, but also eats fruits and other plant matter.)
- What adaptations do skunks possess to ward off predators?
(Answer: Skunks can spray foul-smelling musk very accurately, but they don't have to resort to this tactic every time they're threatened. Their distinct coloration and their unusual pre-spray posture are warning signs, enabling skunks to scare off potential threats without having to expend energy on spraying.)
- The cacomistle is not a known predator of the skunk. What do you think might have provoked the skunk's response to the cacomistle?
(Answers may include: While the cacomistle probably would not attack the skunk, which is much larger than its normal prey, the skunk wants to ensure that there will be no incident. It may also be protecting young skunks hidden nearby.)



8 Short-Tailed Weasel (*Mustela nivalis*)

Family: Mustelidae (Caniformia)

Environment: Mount Katahdin, Maine

This weasel is one of the smallest carnivores. An aggressive animal and fierce hunter, its main prey is small rodents such as the vole, but it also eats berries and other plant material. Despite the size difference, the weasel is more closely related to a bear than a bear is to the big cats in this hall. Both the weasel and the bear belong to the Caniformia group.

GUIDED EXPLORATION:

Physical Form & Hunting Methods

Invite students to explore the postures of the weasel and the vole. Ask:

- What do you think the weasel is looking at? Why? *(Answer: It is looking at the vole.)*
- Think about the weasel's small size. What does this enable it to do?
(Answers may include: The weasel can easily follow small animals like the vole into tunnels and burrows. It also requires much less food than larger animals such as bears or big cats, which could never survive on a diet of voles.)



9 Badger (*Taxidea taxus*)

Family: Mustelidae (Caniformia)

Environment: Jackson Hole, Wyoming

In the same family as the weasel, the badger hunts burrow-dwelling animals like ground squirrels and prairie dogs. It lives in extensive underground dens and can dig astonishingly fast.

GUIDED EXPLORATION:

Physical Form & Hunting Methods

Badgers and coyotes both hunt rodents, but in very different ways. Have students compare the advantages and disadvantages of stalking prey in open country versus pursuing it underground. Ask:

- What features allow badgers to hunt underground successfully?
(Answer: Its large claws and powerful short arms enable the badger to dig and pursue animals that have taken shelter in their home tunnels.)
- Badgers and coyotes both hunt rodents. Which predator do you think would have a better chance of catching field mice?
(Answer: This depends on where the field mice are. The same features that make the stout badgers great diggers make them slow above ground. The long limbs of the coyote enable it to chase and catch its prey in open country.)



Online RESOURCES

Extreme Mammals Exhibition

amnh.org/extrememammals

Check out the biggest, smallest, and most amazing mammals of all time. Find out what makes a mammal a mammal, and trace the ancestry and evolution of this remarkable group of animals.

Moving Mammals

ology.amnh.org/ology/features/movingmammals/

Walk, hop, gallop, swim, glide, burrow, and even swing from trees. Explore this interactive to see how fast, and slow, mammals can move.

Mammal Flipbooks

amnh.org/ology/features/stufftodo_zoology/mammal_flipbooks.php

With more than 5,400 species, mammals move in all kinds of ways. Create flipbooks to see six mammals in action.

Super Teeth

amnh.org/ology/features/stufftodo_zoology/superteeth.php

Mammal teeth are specialized for their diets. Use the matching game and coloring book to explore the four types of mammal teeth: incisors, canines, premolars, and molars.

In Pictures: Extreme Mammals

amnh.org/ology/features/ologist/flynn/inpictures.php

From the extinct *Cynognathus* and *Repenomamus* to the plant-eating dugongs and manatees, explore some of Earth's most unusual mammals.

MAMMAL FACTS

- There are more than 5,400 species of mammals living today.
- Some mammals are hairless, like the river dolphin, while a few others, like the echidna, or spiny anteater, lay eggs.
- Some living groups of carnivorans, such as dogs, have both slicing and grinding teeth. That's why dog food contains vegetables and grain as well as meat.
- The ancestors of many Carnivora were many times larger – or smaller – than their living relatives.
- Carnivorans have special, bladelike teeth called carnassials. When these mammals bite, their teeth shear past each other, slicing like scissors!

CREDITS

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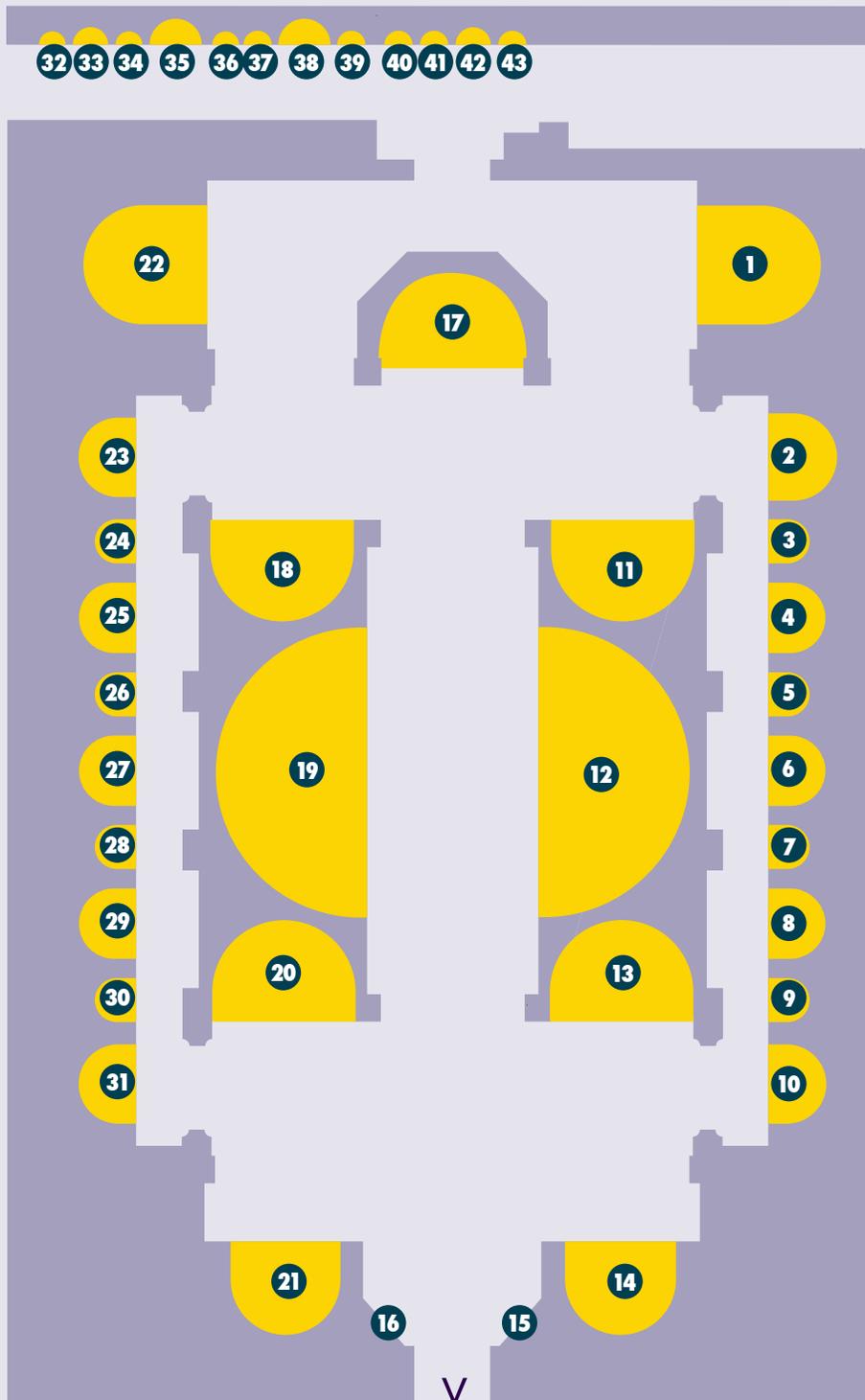


Photo Credits

All diorama photos, coyote skull, and range maps, © American Museum of Natural History. Kinkajou, © Stockbyte/AGE Fotostock. Illustrations of wolf, brown bear, and otter teeth, courtesy of R. Pocock. Illustration of lion teeth, courtesy of H. F. Osborne.

Hall of North American Mammals

As you walk through the Hall of North American Mammals, you'll see breathtaking dioramas that capture every detail of places exactly as they looked when the animals were collected. More than 25 Museum expeditions across this continent produced the specimens displayed in these dioramas.



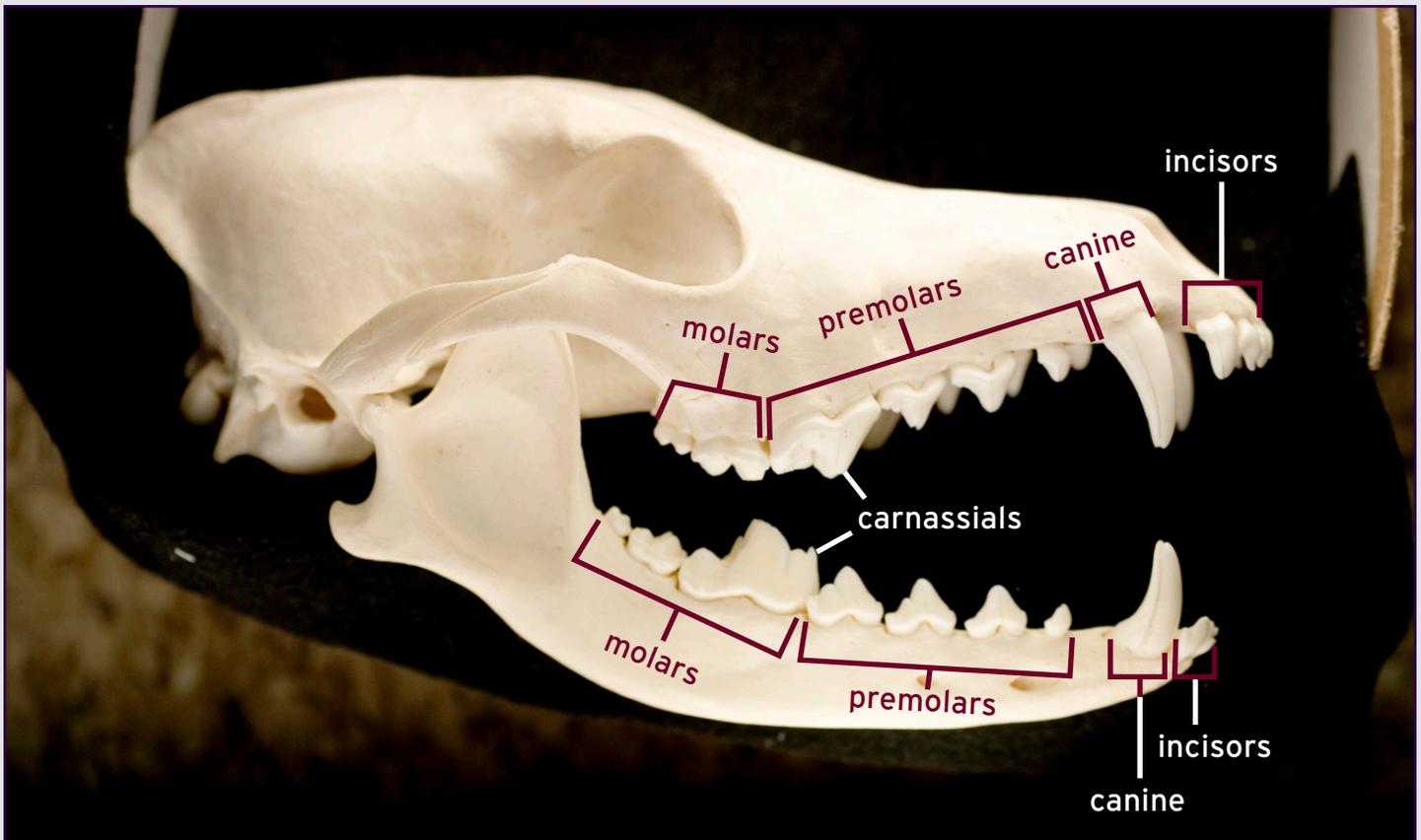
Theodore Roosevelt Memorial Hall

DIORAMAS

1. Cougar (mountain lion)
2. Jaguar
3. Western gray squirrel
4. Canada lynx & snowshoe hare
5. Sewellel (mountain beaver)
6. North American beaver
7. Raccoon
8. Fisher & porcupine
9. Gray fox & opossum
10. Dall sheep
11. Grizzly bear
12. Moose
13. Bighorn sheep
14. Caribou
15. Ice Age – Alaska
16. Ice Age – California
17. Alaska brown bear
18. Mule deer
19. American bison & pronghorn
20. Musk ox
21. Caribou
22. Wapiti (elk)
23. White-tailed deer
24. Striped skunk
25. Coyote
26. Spotted skunk & ringtail (cacomistle)
27. Wolf
28. Eastern cottontail
29. Black bear
30. Black-tailed jackrabbit & antelope jackrabbit
31. Mountain goat
32. American mink
33. American badger
34. Abert's squirrel
35. Wolverine
36. Ermine & southern red-backed vole
37. American marten
38. Collared peccary
39. Northern flying squirrel
40. Groundhog
41. Nine-banded armadillo
42. North American river otter
43. Black-footed ferret

Carnivoran CARNASSIALS

Carnivorans all share particular traits that are found in no other group of mammals—most importantly, a special pair of blade-like teeth called carnassials. The last premolar in the upper jaw has an elongated blade, which shears past a similar one on the first lower molar like scissors. Molars are typically the flat, grinding teeth at the back of a mammal's mouth, and premolars are the teeth between them and the pointed canines.



Skull of Coyote (*Canis latrans*)



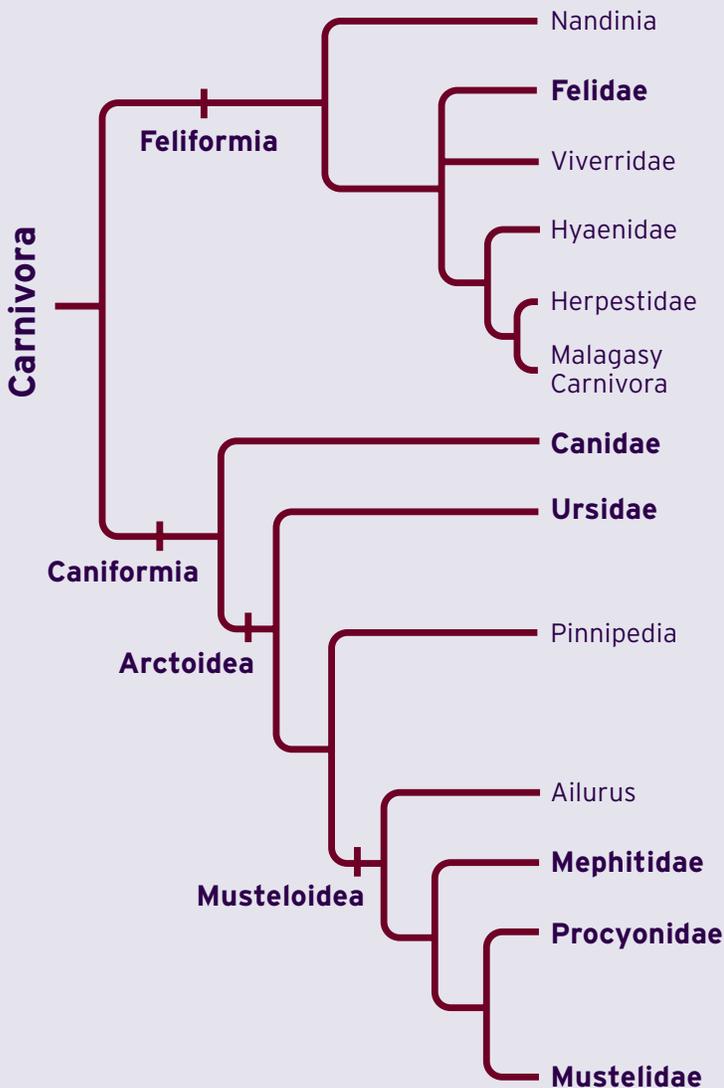
When carnivorans bite, these elongated blades shear past each other, slicing like scissors. This ability to shred meat allows them to digest their food more easily.

Carnivora FAMILY TREE

Scientists create diagrams called cladograms to show how species are related. Like a family tree, a cladogram such as the one below shows close and distant relatives.

The class Mammalia is divided into over 20 orders, one of which is Carnivora. Wherever they're found, all carnivorans—from the jaguar to the weasel—are related because they all share a common ancestor. This distinct group of placental mammals share certain traits such as blade-like teeth called carnassials.

The order Carnivora is divided into two suborders: the catlike Feliformia and the doglike Caniformia. The suborders are further divided into families such as Felidae, Canidae, and Ursidae. Today there are over 270 living species of carnivorans, ten of which are pictured here.



Felidae



Jaguar
Panthera onca



Mountain Lion
Puma concolor



Lynx
Lynx canadensis

Canidae



Wolf
Canis lupus



Coyote
Canis latrans

Ursidae



Alaska Brown Bear
Ursus arctos

Mephitidae



Spotted Skunk
Spilogale putorius

Procyonidae



Cacomistle
Bassariscus sumichrasti

Mustelidae



Short-Tailed Weasel
Mustela nivalis



Badger
Taxidea taxus