

Teacher's Guide

The Kenneth E. Behring Family
Hall of Mammals



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Overview

The Kenneth E. Behring Family Hall of Mammals is a 22,500 square foot exhibit that combines the latest scientific views on mammals with a modern and artistic style of display. Nearly 300 exquisite specimens of living species and key fossils fill the Hall in stunningly renovated early 20th century architecture.

The Hall is arranged both geographically by continents and by grouping closely related mammals (see box at right). An entrance orientation area gives an overview of the important concepts underlying the displays.

The Hall focuses on a few major concepts.

- **Definition**—What is a mammal? *The uniquely shared characteristics of mammals—hair, milk producing glands, and three middle ear bones—define the group.*
- **Unifying Characteristics**—How can we account for the unifying characteristics of mammals? *The answer is common ancestry, the descent of all living members from a single group representing the earliest true mammals that scurried over the earth more than 200 million years ago.*
- **Evolutionary Diversity**—How did mammals multiply and diverge from a single group to more than 5,000 living species inhabiting every ocean and continent? *Moving continents, changing landscapes, shifts of climate, and isolation provide the setting for evolution to act on mammals over a 200 million year period.*

Within these three major themes there are subthemes, such as adaptation, ecosystems, food chains and webs, behavior, comparative anatomy and functional morphology, classification, natural selection, extinction, and the fossil record.

All age groups will find the Hall appealing in a number of ways. The best reason is the fabulous display of specimens. The specimens are unquestionably the stars, but there are also Discovery Zones where visitors may use interactives, touchables, and videos. These multimedia creations are sure to grab attention, provoke curiosity, and encourage visitors to connect personally with the subject matter.

Messages throughout the Hall are written to reflect the National Science Education Standards and Benchmarks for Life Science (Standard C). A table in this guide correlates areas of the Hall with standards for grade levels K – 4 and 5 – 8. In addition, the following pages include brief interpretations for each of the six main areas of the Hall, a vocabulary list, an online list of resources, and a few suggestions for your visit.

Continents Explored:

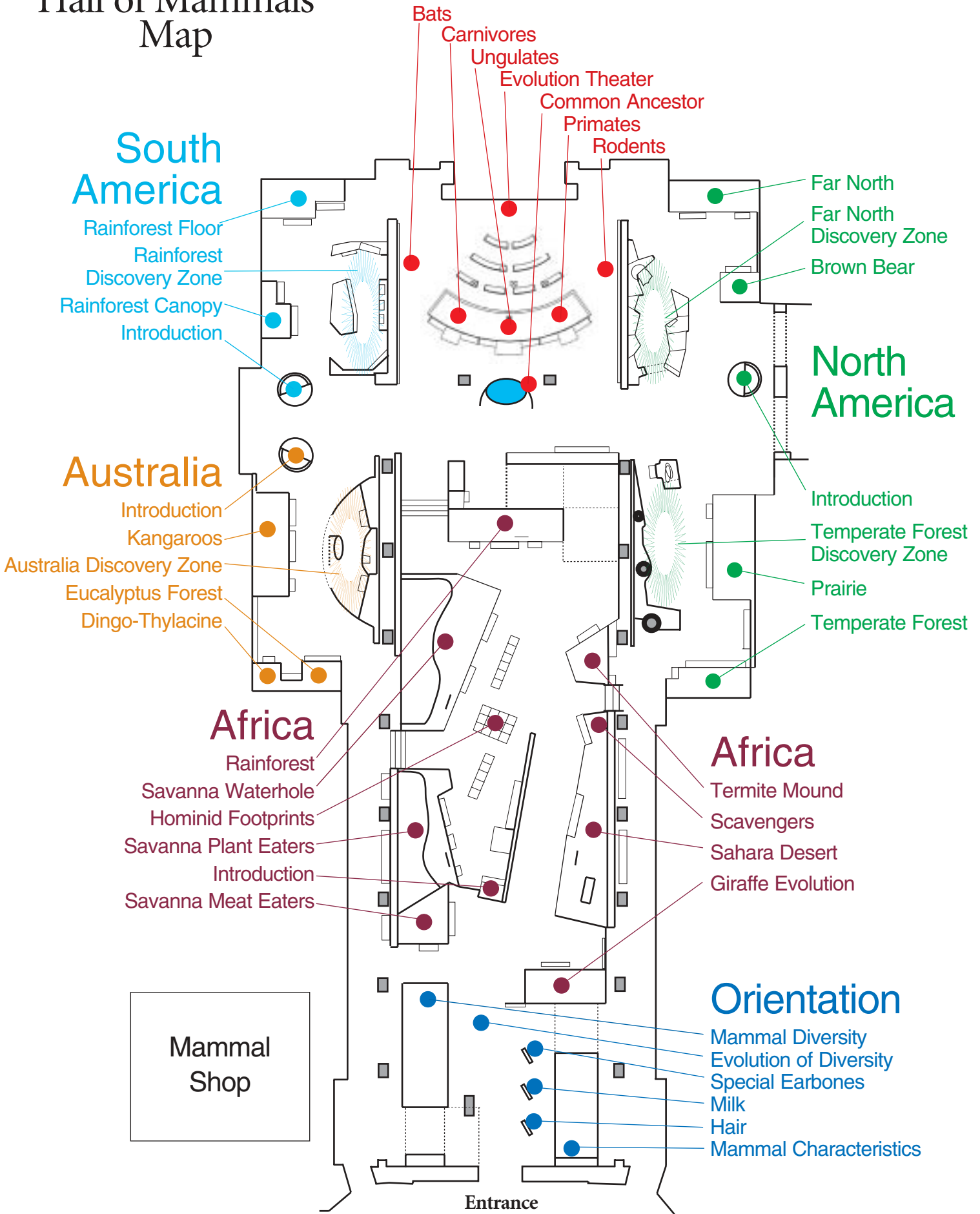
Africa
Australia
South America
North America

Taxonomic Groupings:

bats
carnivores
primates
rodents
ungulates

The Kenneth E. Behring Family
Hall of Mammals
 Map

Family Gallery



Orientation



The important threads connecting every section of the Hall are introduced at the Hall entrance. A series of displays helps visitors to understand what it means to be a mammal. Knowing the defining characteristics of mammals shapes a picture of unity for this group and is fundamental to appreciating the extraordinary range of diversity within mammals. Diversity takes center stage as the single greatest mystery to be explained. In accounting for both unity and diversity, the evolutionary history of mammals plays a major role, and the key concepts of common descent, speciation, and adaptation are linked to earth's changing climate and landscape.

Key Concepts

Mammal Characteristics—unique features uniting all members of the group: hair, milk-producing glands, and three middle ear bones.

Mammal Diversity—bewildering differences in form, behavior, reproduction, diet, lifespan, and intelligence are displayed by mammals, from a 1.5 gram bat to a 150 metric ton whale, from mammals that fly or glide to those that live entirely underground, or in the open ocean. Around 5,000 species, 1,100 genera, 139 families, 30 orders, and 2 subclasses hint at their diversity.

Common Ancestry—inheritance of defining and unifying characteristics can be traced from a single ancient group.

Adaptation—a characteristic that, under the right environmental conditions, improves the chances of a species surviving or reproducing, such as the digging forelimbs of a mole.

Evolution—any change in the genetic composition of a population over generations caused by such mechanisms as chance events and natural selection.

Classification—the ordering of groups of organisms on the basis of their evolutionary relationships as inferred from their uniquely shared characteristics.

Africa



When true mammals arose from mammal-like reptiles more than 200 million years ago, Africa was at the center of the great conglomeration of continents known as Pangea. Over time, a relatively cooler and drier climate has changed the extent and composition of this continent's ecosystems. North Africa is especially arid; the Sahara desert is one of the driest and hottest places on the planet. Dense rain forest spans equatorial Africa from the West African coast east to Kenya. East Africa supports expansive grasslands that run great distances north to

south. All three ecosystems are on display in the Hall.

Key Concepts

Adaptations—armor, meat-eating, communication, coping with drought, coping with heat, crypsis (through disruptive coloration), giraffe's niche, horns and other headgear, insect-eating, migration, plant-eating, predator-prey interactions.

Rain Forest—see South America.

Desert—arid region receiving less than 250 mm (10 inches) of rain annually; usually quite hot. Deserts display significant biodiversity, and desert mammals beat the heat and aridity through surprising adaptations.

Savanna—tropical, seasonal ecosystem with varying mixes of grasses, trees, and shrubs.

Waterhole—fluctuating reserves of surface water that diminish during the dry season and are replenished by seasonal rains. Mammals concentrate at waterholes, both for the water itself and for more succulent and nutritious plants growing around the edges. Waterholes also attract carnivores that prey on the herbivores.



Australia



The driest and most isolated continent on earth, Australia has nearly 300 species of mammals. Some never take a drink. More distinctive is that some types actually lay eggs, but most belong to the group of pouched mammals known as marsupials. The splendid isolation of the island continent has resulted in a uniquely fantastic evolution of mammals. Here evolution worked in isolation and yet often produced convergences of adaptations found in mammals inhabiting other continents.

Key Concepts

Adaptations—locomotion (arboreality, bipedal hopping, gliding, flying).

Marsupial—defined by a unique mode of reproduction, this diverse group of mammals give birth to their young at a very early stage of embryonic development. Once born, the blind and naked newborn journeys unaided to an abdominal pouch containing nipples. Once inside, the “pouch-embryo” locks onto a nipple, where it remains attached until jaw development catches up and it can open and close its mouth.

Monotreme—egg-laying mammals, such as the duck-billed platypus, with a single, multi-function passage known as a cloaca. The cloaca joins the uterus, uro-genital and excretory passages. Once laid, eggs hatch in about 10 days and the newborns depend on the mother’s milk for continued development.

Convergent Evolution—similar features or behaviors acquired independently by distantly related organisms.

Specialization (Koalas and Eucalyptus Forest)—Koalas depend on the tough leaves of eucalyptus for food. Eucalyptus foliage is high in fiber and potential toxins, and low in nutrition. Koalas manage a diet of eucalyptus by inactivating and excreting the toxic compounds and by minimizing their energy requirements. They are typically inactive for 20 hours a day.

Extinction—the irreversible loss of a group, such as the Tasmanian wolf (thylacine).

South America



More species of mammals coexist in South America’s Amazonian rain forest than at any other place on earth. As lush as this rain

forest is, dripping with ferns, bromeliads, orchids, and lianas, it does not produce unlimited food resources. Through coevolution mammals have reduced competition for these resources by acquiring special adaptations. The Amazon rain forest re-creation uses focal species and exceptional detail to show how mammals partition this ecosystem by occupying unique niches.

Key Concepts

Adaptations—arboreality, diet (insects, sap, blood, flesh, tough plants), echolocation, feet and claws (digging, clinging, running, climbing, stalking in silence), flight, lowered metabolism, night vision, prehensile tails, and protective fur.

Habitat—the characteristics of the place where a species normally lives.

Niche—the role of a species within a community, including the species’ interactions with all other organisms within the habitat, its biology, life history, how it accesses food, locomotes, reproduces, and behaves. Unique adaptations help define the niche.

Tropical Rain

Forest—like other tropical rain forests, the Amazon is largely a broadleaf evergreen forest that receives a winning combination of strong equatorial sun and over 100 inches of annual rainfall. Most rain falls seasonally and inundates the lowland floodplain known as varzea. Over time, mammals have developed ways to cope with the disappearing terra firma.

North America



This continent has extreme climatic conditions ranging from semitropical in the southernmost regions, to the frozen Arctic, but it is the seasonal swings in temperature, precipitation, and food resources that challenge North American mammals most. Forests and grasslands burst with new growth each spring followed by a reversal each fall when leaves die and the lush, green landscapes whither away. In this area of the Hall, two mostly treeless and two forested communities are recreated—prairie and tundra, and temperate forest and taiga.

Key Concepts

Adaptations—energy conservation, energy stores, locomotion, camouflage, migration, seasonal birthing, nesting, and life underground, in trees, and in water.

Speciation—one species giving rise to another, such as polar bears evolving from brown bears.

Prairie—tracts of land dominated by mixed grasses with some shrubs and trees. In North America, the more western zones tend to be drier and with shorter grasses than the tall grass prairies to the east. Harsh winters and short growing seasons depict this environment.

Tundra—an extreme northern or alpine environment where sedges, heath shrubs, dwarf trees, grasses, mosses, lichens, peat bogs and

marshes dominate. Plants grow above the permanently frozen ground known as permafrost.

Temperate Forest—includes a diversity of forest types with different mixes of broadleaf and coniferous trees and shrubs. Forests can contain a variety of species, such as birch, aspen, poplar, maple, oaks, hickory, hemlock, pine, fir, and spruce. A mix of lakes, glades, barrens, bogs, and marshes add to the biodiversity.

Taiga—severe winters, short and cool summers, and poor soils are the setting for forests of the far north. Black spruce, white spruce, jack pine, balsam poplar, balsam fir, tamarack, trembling aspen, and white birch dominate these northern forests.

Family Gallery & Evolution Theater



Four Orders of mammals are displayed in their respective groups—bats, carnivores,

primates, and rodents. Ungulates make up a fifth case of specimens: these are the hooved mammals. They represent a number of related orders that together belong to a higher-ranking group, a Grandorder known as the Ungulata. The primary message in the Gallery is that the unique characteristics uniting diverse groups can be attributed to common descent from a shared ancestor. Also within this area, an eight-minute film summarizes the major events in the evolutionary history of mammals.

Key Groups

Bats—the only true fliers among mammals, and unlike some birds that are flightless, there are no bats that cannot fly.

Carnivores—known for eating other vertebrates, and for their specialized shearing teeth.

Primates—monkeys, apes, lemurs, tarsiers, and humans, which have grasping hands and feet, complex brains, and nails rather than claws.

Rodents—characterized by chisel-like, ever-growing incisors and their ability to gnaw through tough materials.

Ungulates—the plant-eating, hooved mammals with extra-long feet.

Fossil—*Morganucodon oehleri* (210 million years ago), an extinct mammal belonging to a group that is close to the common ancestry of all mammals.

Key Concepts

Adaptations—carnivory, herbivory, gnawing, flight, arboreality, and long-distance running.






Common Ancestor—a group that gave rise to two or more new groups of organisms or lineages.

Homology—characteristics shared by two or more groups of organisms due to the presence of the feature in the last common ancestor of the groups.




Hall of Mammals

Planning a Trip to the National Museum of Natural History

Before making a class visit

-  If possible, visit the Museum and tour the Hall prior to bringing a group of students. Knowing the layout and contents of the Hall and the locations of bathrooms, drinking fountains, and the cafeteria goes a long way toward having a smooth trip. Also, understanding Museum security will help your group make an efficient entry into the building. All visitors must pass through bag screening and metal detectors, much as you would encounter at an airport.
-  Plan on bringing one chaperone for every five students.
-  Review **key concepts** and **vocabulary** with the students to help increase their interest and understanding of the Hall.
-  Look over the resource list provided online at http://www.mnh.si.edu/edu_resources.html; it will help you put together background reading and provide students with supplemental materials.
-  Visit the Hall of Mammals online at <http://www.mnh.si.edu/mammals>.

After visiting the Museum

-  Review the key concepts and vocabulary to reinforce the lessons learned in the Hall. Also, getting students to cite examples or do activities that support those lessons will add meaning to the visit and provide students with more time to make sense of seeing nearly 300 mammals.
-  Direct students to *North American Mammals* (<http://www.mnh.si.edu/mna>) to discover which types of mammals live in your area. Using the interactive map, create a field guide for the mammals in your area.
-  Have students keep a record of the mammals they identify from your area. They can also record observations in the space provided for notes. Here are a few useful categories for recorded behaviors: what a mammal is eating, how it is behaving, how it is vocalizing, and whether or not it is interacting with other animals.

Vocabulary

Most terms are selected from the exhibit and may not be understood by elementary and middle school students.

| | | | | |
|--------------|---------------|---------------|------------|------------|
| antlers | chisel | fossil | insulation | nocturnal |
| biodiversity | communication | gene | marsupial | noxious |
| camouflage | competition | gnaw | metabolism | prehensile |
| canine teeth | diurnal | hibernation | migration | scavenger |
| canopy | DNA | horns | monotreme | species |
| cheek teeth | echolocation | incisor teeth | mortality | ungulate |

National Science Education Standards

The table cross-references Life Science Standards (C) that are addressed by the Hall of Mammals. These standards were developed by the National Academies, approved by the Governing Board of the National Research Council, and published in 1995. They have since served as a guide for science standards throughout the states, in both the public and private sectors.

Grades K – 4

| | Orientation | Africa | Australia | South America | North America | Family Gallery |
|--|-------------|--------|-----------|---------------|---------------|----------------|
| The Characteristics of Organisms | | | | | | |
| Components of survival. Distinct environments support distinct life. | | ✓ | ✓ | ✓ | ✓ | |
| Different structures serve different functions. | | ✓ | ✓ | ✓ | ✓ | ✓ |
| Influences on the behavior of individual organisms. | | ✓ | ✓ | | ✓ | |
| Life Cycles of Organisms | | | | | | |
| Inheritance of characteristics. | ✓ | ✓ | | | | ✓ |
| Organisms in Their Environment | | | | | | |
| Patterns of behavior relating to environments. | | ✓ | ✓ | ✓ | ✓ | |
| Changes in Environment | | | | | | |
| Scale and duration of changes in environments. | | ✓ | ✓ | ✓ | ✓ | |

Grades 5 – 8

| | Orientation | Africa | Australia | South America | North America | Family Gallery |
|--|-------------|--------|-----------|---------------|---------------|----------------|
| Structure and Function in Living Systems | | | | | | |
| Systems and ecosystems—digestion, locomotion, and reproduction. | | ✓ | ✓ | ✓ | ✓ | |
| Reproduction and Heredity | | | | | | |
| Inheritance, characteristics, and interactions with the environment. | ✓ | | | | | ✓ |
| Regulation and Behavior | | | | | | |
| Maintaining stable internal conditions in a constantly changing environment. | | ✓ | | | ✓ | |
| Behavior as a response to stimuli. | | | | | ✓ | |
| Behavior as an evolutionary adaptation. | | | | | ✓ | |
| Populations and Ecosystems | | | | | | |
| Biodiversity and population density depend on resources available, and on abiotic factors. | | | | ✓ | | |
| Diversity and Adaptation of Organisms | | | | | | |
| Unity accounted for by uniquely shared characteristics. | ✓ | | | | | ✓ |
| Diversity accounted for by biological evolution. | ✓ | ✓ | ✓ | ✓ | ✓ | ✓ |
| Extinction and the fossil record. | ✓ | ✓ | ✓ | | ✓ | ✓ |

