
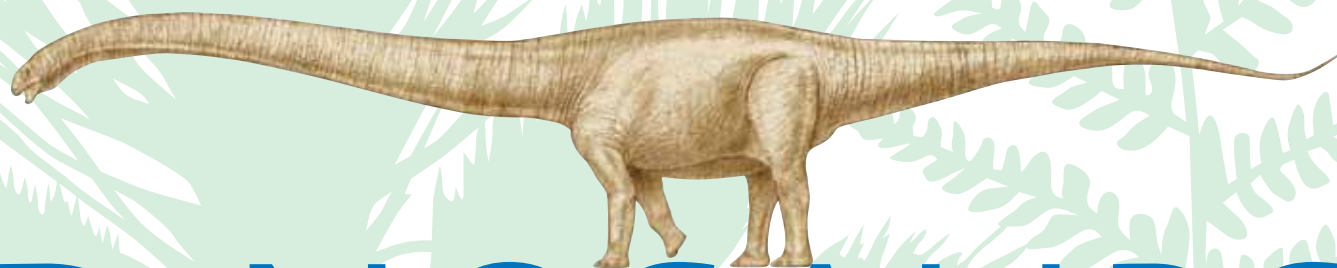


ROTUNDA

 AMERICAN MUSEUM OF NATURAL HISTORY

Members' Magazine
Spring 2011 Vol. 36 No. 2

THE WORLD'S LARGEST



DINOSAURS

HOW TO MAKE
A MASSIVE MODEL



HOW SAUROPODS
GOT SO BIG



HOW SCIENTISTS STUDY
APATOSAURUS'S BRAIN

From the President

Ellen V. Futter



Every year we greet spring with a sense of anticipation and renewal. But this year, after our long and unusually wintry winter, spring feels especially welcome. It's a time not just to open windows, but to open ourselves—to expand our minds, to learn something fresh and exciting, and, as always, to be inspired by the natural world. The Museum is here to help you do just that, with a stimulating range of programs to feed your mind and broaden your point of view.

Our always-popular Spring Bird Walks in Central Park take you deep into this vibrant natural oasis in the heart of Manhattan. To bring nature even closer to home, learn about Rooftop Farming (April 27) and Urban Beekeeping (May 11). Or stop by on Identification Day (June 4) and let a scientist help you identify that mysterious find from your backyard—is that an arrowhead? A meteorite? We'll let you know.

For a provocative experience, the Museum will bring together, for the first time in 30 years, the celebrated paleoanthropologists and long-time rivals Richard Leakey and Donald Johanson for a spirited discussion about their careers, their differences, and the latest breakthroughs in human evolution. If you enjoy conversation in an informal, after-hours setting, the Museum's monthly SciCafe brings you "up close and personal" with leading scientists and intriguing science.

Finally, we love to take our Members behind the scenes and show you what makes us tick. This spring, the Department of Herpetology and the Center for Biodiversity and Conservation will host Members for special evenings.

There's a lot to do and a lot to be inspired by. I hope you have the opportunity to look through a few new windows that we are pleased to throw open for you this spring.

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ROTUNDA

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Museum Education Tool Wins Prestigious Award



Resources for Learning (RFL), an innovative online catalog of educational content for teachers and students developed by the American Museum of Natural History, received the coveted *Science Prize for Online Resources in Education* (SPORE) this winter—a first for a natural history museum. The award, sponsored by the journal *Science*, recognizes outstanding free online educational materials that enrich science learning.

Resources for Learning brings the Museum's robust scientific resources—more than 200 active scientists, one of the world's most extensive physical collections, innovative exhibitions, and more—to a broader audience beyond the walls of the Museum in a single, easily accessible, and free online compendium for science educators and students. Aggregating more than 1,200 distinct digital resources, from articles and activities to media-rich content like videos and exhibition interactives, the RFL catalog includes content developed specifically for the Museum's permanent halls and temporary exhibitions, as well as content from two of the Museum's flagship online programs, *Science Bulletins* and *OLogy*.

Rosamond Kinzler, senior director of the National Center for Science Literacy, Education and Technology (NCSLET), the group within the Museum's Education Department responsible for creating Resources for Learning as well as *Science Bulletins* and *OLogy*, and Steve Gano, director for education in the Digital Media department, noted in their essay in *Science* that evidence shows "that when teachers bring museum resources into the classroom, students' engagement in both the content and practice of science increases."

The development of Resources for Learning was made possible by a grant from The Louis Calder Foundation. The National Aeronautics and Space Administration provided significant educational and programming support.



The Spitzer Hall of Human Origins explores the remarkable story of human evolution.

Leakey and Johanson to Speak on Human Evolution

Two of the world's top hominid fossil hunters—Richard Leakey and Donald Johanson—will reunite at the Museum this spring after 30 years to participate in a unique evening program, "Human Evolution and Why It Matters: A Conversation with Leakey and Johanson," on Thursday, May 5, at 6:30 pm. "Richard Leakey and Don Johanson have been responsible for some of the most important paleoanthropological discoveries of the last 50 years," says James H. Simons, a Museum supporter who suggested that the Museum host this historic discussion. "Given their immense knowledge of human origins and their crucial roles in contributing to the story, they are uniquely qualified to shed light on this fascinating topic."

This rare meeting of the minds comes nearly three decades after Walter Cronkite first brought the two leading paleoanthropologists together at the Museum for a taping of *Cronkite's Universe*. The edition focused on the two scientists' diverging ideas about the origins of the human family.

The topic is no less urgent today. Just four years ago, the Museum opened the Anne and Bernard Spitzer Hall of Human Origins, a new permanent hall that explores the remarkable story of human evolution by drawing on evidence from the fossil record and genomic data.

Leakey and Johanson have each spent decades working to unearth the physical record of human evolution. Their contributions include the discoveries of two of the most significant hominid fossil specimens of the late 20th century: the 3.18-million-year-old *Australopithecus afarensis* skeleton, nicknamed "Lucy," which was found by Johanson in Ethiopia in 1974, and the 1.6-million-year-old *Homo erectus* skeleton known as "Turkana Boy," discovered by Leakey near Lake Turkana, Kenya, 10 years later.

On May 5, Leakey and Johanson will discuss their experiences in the field, including the stories behind their extraordinary finds, reflect on the competition that fuels evolutionary research, and look ahead to the next 10 years.

To learn more and to purchase tickets, visit amnh.org/calendar.

This event is being held in partnership with the Arizona State University Institute of Human Origins and the Turkana Basin Institute, based in the U.S. at Stony Brook University.

Photos © AMNH/D. Finnin

Ghost Bird

At 20 inches long with a 30-inch wingspread, the Ivory-billed Woodpecker was one of the largest woodpeckers in the world and lived in old-growth forests of the southeastern United States. The last authenticated sighting took place in the 1940s. Two related species, the Cuban Ivory-billed Woodpecker and the Imperial Woodpecker of Mexico, are also thought to be extinct.

A Comprehensive Collection

The Museum’s Department of Ornithology maintains almost a million bird specimens, including more than 800,000 skins organized in trays that take up six floors, plus skeletons, tissue samples, eggs, nests, and preparations in alcohol. The collection includes specimens from every continent and ocean, and represents close to 99 percent of all bird species, from the tiny Cuban Bee Hummingbird to the Ostrich.

Key Acquisitions

In 1883, 48 ornithologists met at the Museum to form the American Ornithologists’ Union. Joel A. Allen, its president, became the Museum’s first curator of the Department of Ornithology and Mammalogy (later split into two departments); he acquired 39,000 bird specimens by 1887. In 1932, the department acquired a collection of 280,000 specimens from Lord Rothschild, paving the way for greater growth in the years to come.

Accessing the Data

Many of the Museum’s ornithology specimens—along with the records of their origins—date back to the mid-19th through early 20th centuries. Museum staff members are now in the final stages of transferring information about individual specimens from more than 50 volumes of hand-written ledgers to an electronic database that is available to researchers through ORNIS, a project funded by the National Science Foundation that aggregates information from more than 40 institutions in five countries.

Woodpecker Research from the Museum

Museum staff members Peter Capainolo, Shannon Kenney, and Paul Sweet performed the Ivory-billed wing study and reported their results in the professional journal *The Auk*. Among other woodpecker projects at the Museum: Associate Curator George F. Barrowclough is researching their DNA phylogeny; Curator-in-Charge Joel L. Cracraft has published research on fossil woodpeckers; and Curator Emeritus Lester Short wrote *Woodpeckers of the World*.



Catalog no. AMNH 2482

Sightings and specimens: Campephilus principalis

Six years ago this spring, an announcement sent waves of excitement among birders and wildlife enthusiasts: an Ivory-billed Woodpecker, *Campephilus principalis*, generally thought to be extinct, had been sighted in an Arkansas swamp by a team of investigators. A blurry video of the large bird in flight seemed to provide supporting evidence.

Still, proof of the bird’s existence was not airtight. Subsequent visits, as well as audio and video recordings in the area, yielded no definitive results. The video showed an image that might have been that of a similar species, the Pileated Woodpecker. Both species have black and white wings, but with different patterns that are visible when the wings are extended in flight. While researchers fanned out to look for evidence in Arkansas, at the Museum, ornithologists turned to the collections to examine the wings.

The Museum’s Department of Ornithology’s vast collection includes several specimens of the Ivory-billed Woodpecker, most of which were collected more than a century ago. But, like specimens in other institutions around the world, virtually all of the collected samples showed the wings closed or only slightly open. Three Museum scientists painstakingly worked with a 117-year-old Ivory-billed specimen to carefully remove a wing, extend it, and display it for comparison with wings from Pileated samples. Given the quality of the video, their work did not settle the debate over the Arkansas sighting, but it added an important data point—and produced a detailed roadmap for preparing very old specimens for examination.

Collections are often tapped for clues of a different sort, too. “Extinct bird specimens yield DNA samples that can be used to study relationships among species and answer questions about evolution and biogeography,” says Paul Sweet, who oversees the ornithology collection.

Meanwhile, back in Arkansas, the search continues.

Join ornithologist Paul Sweet on a Members’ excursion to New Jersey’s Great Swamp Refuge on May 14. See page 15 for details.

Photo © AMNH/R. Mickens

Laboratory Superstar: Xenopus laevis

Although the cloning of Dolly the Sheep made headlines in 1996, more than 30 years earlier an unsung player quietly paved the way. The African clawed frog, *Xenopus laevis*, long regarded as an excellent laboratory animal, made its mark in 1962 as the first vertebrate to be cloned successfully. Even earlier—in the 1930s—this frog served as the medium for a reliable human pregnancy test. The species ventured into space on the space shuttle Endeavor, where scientists were studying the effect of zero gravity on reproduction and development, and it is also popular among molecular biologists studying DNA replication.

It is no accident that the African clawed frog is such a research overachiever. As a purely aquatic animal, it requires little space. It is hardy and adaptable, with some individuals living more than 20 years in captivity. The species is easy to breed and care for; females lay large numbers of transparent eggs, enabling observers to study developing young from the first cells to the tadpole stage.

This frog has also been popular as a pet since the 1950s, traveling far beyond its native southern African home. Its popularity, however, has a downside: many of these voracious predators have escaped and gone feral, threatening native species in freshwater areas worldwide. Even more ominously, the African clawed frog has been implicated in the spread of amphibian chytrid fungus, a disease of epidemic proportions that is threatening frog populations around the world and may be responsible for the extinction of some species.

Museum visitors can see live African clawed frogs in the Museum’s Discovery Room and, starting May 28, in the exhibition *Frogs: A Chorus of Colors*.

Members receive discounted tickets to *Frogs: A Chorus of Colors*. For more about the exhibition, visit amnh.org/exhibitions/frogs. *Frogs: A Chorus of Colors* is presented with appreciation to Clyde Peeling’s Reptiland.



Xenopus laevis

Photo © istockphoto.com/Eric Isselee

Rotunda / Spring 2011 / AMNH.org

Pond Life

African clawed frogs have no tongues or teeth. Claws on their webbed hind feet and elongated fingers enable them to stir up mud on pond bottoms to get at worms, insects, mosquito larvae, and organic matter. These aquatic frogs remain submerged and motionless much of the time to avoid predators. To get oxygen or food, they suddenly spring to life, surface, and gulp the air or insect quickly, before resuming their underwater defensive behavior.

A Splashy Debut

When invited to bring frogs on “The Late Show with David Letterman,” Associate Curator Christopher Raxworthy chose this species because he thought viewers would enjoy seeing immobile frogs in a tank of water suddenly leap for worms.

Speaking Their Minds

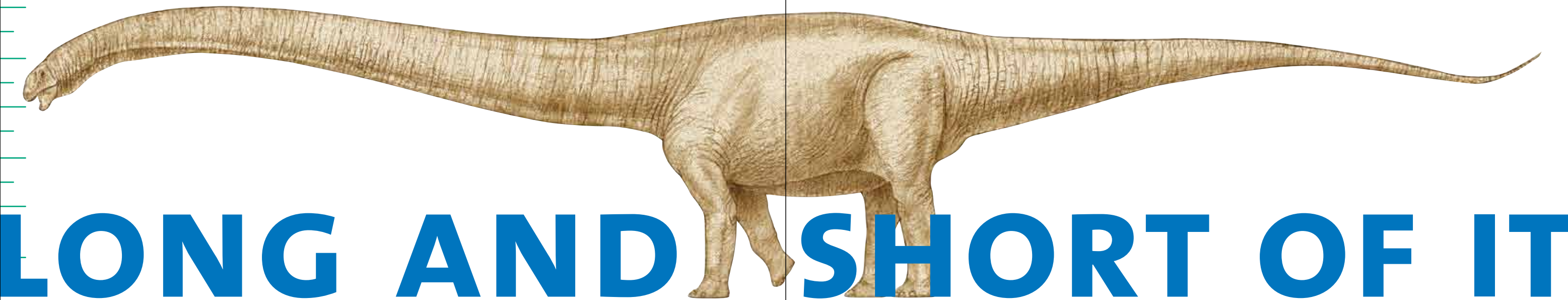
Frogs were the first land animal with vocal chords. Males of certain species have vocal sacs that fill with air and make sounds that can be heard from as far as a mile away. African clawed frogs have an unusual distinction: females can vocalize too, and males and females call to each other under water.

Frog Research Powerhouse

The Museum’s Department of Herpetology has one of the largest collections of frog specimens in the world, with some 2,500 species, or more than half the known species, represented. The department maintains the authoritative online database on living amphibians, *Amphibian Species of the World*, which is used by 8,000 researchers each month. Museum scientists are also responsible for identifying more than 160 new frog species.

Populations in Decline

Frog populations worldwide have dropped dramatically in the last 50 years. Museum researchers are working to identify causes and conservation needs. Threats include loss of habitat, invasive species, climate change, pollution, and disease—most notably, amphibian chytrid fungus disease, which is wreaking havoc globally. African clawed frogs, which have been traded internationally since the 1930s, are thought by many to play a role in the spread of the disease.



LONG AND SHORT OF IT

THE ART, SCIENCE, AND CUTTING-EDGE TECHNIQUES BEHIND THE MAKING OF A MASSIVE MODEL

Fabricating the life-sized model of the sauropod *Mamenchisaurus hochuanensis* at the center of the new exhibition *The World's Largest Dinosaurs* is a very big job: the model measures 60 feet long and stands 11 feet high at the shoulder; the neck alone is nearly 30 feet long.

But it's all in a day's work for sculptor Hall Train and his colleagues at Hall Train Studios in Mississauga, Ontario, Canada, a team that has made everything from singing Hogwart's frogs for the Harry Potter theme park in Orlando, Florida, to untold numbers of scientifically accurate dinosaur and other animal models for museums across North America.

Essential to the success of designing a huge creature that no human has ever seen is working closely with the exhibition curators, Mark Norell, chair of the Division of Paleontology at the Museum, and guest co-curator Martin Sander of the University of Bonn, Germany.

"We communicate over the internet a lot," says Norell, showing a typical email in which Train sent him an image of a small sculpture he had made, along with a question about the exact angle of the head. "The internet has made it much easier, sending pictures back and forth."

Such refinements go on right down to the final finishes and may even continue afterward if adjustments are needed to accommodate different venues when the exhibition goes on the road.

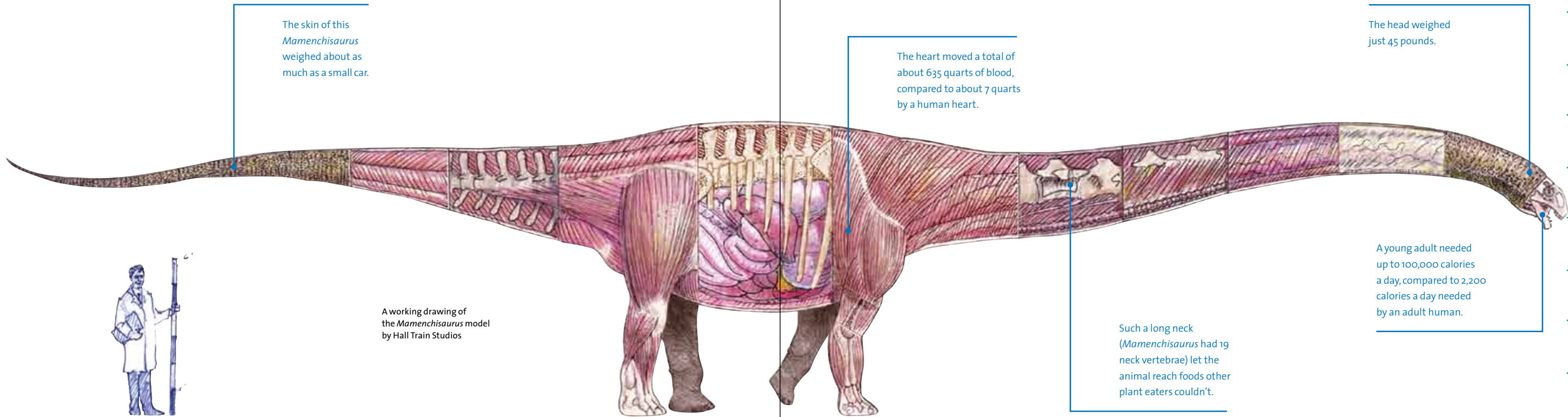
Along with the constant scientific vetting, creating the model of *Mamenchisaurus* involved a complex combination of computer imaging, mechanical processing, and skilled, hands-on work.

"While we have created so many highly realistic models of living and extinct animals—even mythical dragons and unicorns—creating an enormous life-sized sauropod to take center stage is a monumental, fascinating undertaking," says David Harvey, senior vice president for Exhibition. "Coordinating talented exhibition designers and preparators with key scientists, engaging specialized fabricators, and keeping an eye on scientific accuracy and educational goals—this one really pulls out all the stops."

One of the biggest technical challenges was, naturally enough, size. In traditional modeling—a technique pioneered by the Museum's own Carl Akeley in the early 20th century—a life-sized form is sculpted in clay over a metal or wood skeleton, with as much textural detail on the exterior as possible. Then, plaster is poured over the sculpture, left to harden, and split open to serve as a template for a final, lightweight papier-mâché or resin model that can be painted and finished or, in the case of real animals, fitted with actual skins. The original sculpture is generally discarded. Theoretically, that method could be used for any size model. Train himself has used it for many projects in the past, substituting silicone, polyester resin, and fiberglass for the plaster template and resin and fiberglass for papier-mâché. But increasingly sophisticated computer software has made the need for an original true-to-size sculpture unnecessary.

For the *Mamenchisaurus*, Train did make a real sculpture—but a relatively tiny 5-foot-long one, made of polymer clay that he baked into a hard plastic. He then made an image of it with a special scanner, built by Arius 3D. This 3D computer model was scaled up for size and then "broken down" digitally into manageable sections that formed the basis for Styrofoam templates or molds for the nearly ►

A working drawing of the *Mamenchisaurus* model by Hall Train Studios



**The World’s Largest Dinosaurs
Opens Saturday, April 16**

How did a 60-foot dinosaur live, breathe, eat, and move? This exciting exhibition features the latest research about super-sized sauropods—including the giant *Mamenchisaurus*, one of the largest animals ever to walk the Earth—and offers new insights into how their colossal bodies functioned. Visitors will have a chance to examine life-sized bones, muscles, internal organs, and more to discover the amazing anatomy of *The World’s Largest Dinosaurs*.

The exhibition will also include specimens from the Museum’s world-renowned fossil collection, including sauropod limbs, brain endocasts, vertebrae, skin impressions, and a variety of other specimens. An interactive station at the end of the exhibition will introduce visitors to how dinosaurs are discovered in the field through a replicated dig site.

The exhibition is curated by Mark Norell, chair of the Division of Paleontology at the American Museum of Natural History, and guest co-curated by Martin Sander of the University of Bonn, Germany.

100 pieces that were eventually fashioned into the final super-sized model. The 3D scan of the sculpture was also used to design an interior armature or “skeleton” for the actual model made, according to those specifications, out of steel and aluminum at Heartland Scenic Studio in Omaha, Nebraska. Train’s original sculpture can be seen in an interactive feature designed by the Museum’s exhibition media team in which visitors look through a viewer to see the model sport different skin color schemes. Train also created stand-alone 3D models of the sauropod’s heart and lungs.

Factored into the final design of the large model were two varying views. One side displays underlying biological features: muscles, ribs, vertebrae. At the center, a smooth white surface serves as a screen for a projected animation—produced by Helene Alonso, head of the Museum’s exhibition interactives and media team—which delves deeper into the creature’s internal organs to show the heart, lungs, and digestive and other systems at work. The opposite side is simply fleshed out with skin, which presented another challenge for this project because of the texture of *Mamenchisaurus* skin, the feel of which Train likens to an ostrich’s leg.

“Dinosaur skin is like myriad pebbles, each a different size,” Train explains. To achieve such finely detailed texture, a digital artist in Train’s Cork, Ireland, studio used a computer sculpting program called ZBrush to create an “infinite digital dinosaur skin” that he could apply all over the 3D computer model for the most realistic effect. “You have to create a graphic version of what the skin looks like,” Train explains. “Then you can manipulate it, skew it, compress it, expand it, get it to do all the things a dinosaur’s skin should do.”

In what is literally cutting-edge technology, the completed computer files were used to direct the movements of a mechanical router within a tenth of a millimeter to carve all the sculptural details, including the highly realistic skin texture, onto the surface of the actual Styrofoam molds.

The processed molds were shipped to the Museum’s Exhibition Department’s vast studio on the fifth floor, where they were lined first with color-stained

epoxy resin—the flexible, super-strong stuff of fighter planes—and then two layers of epoxy-impregnated fiberglass. Once cured, the lining was released by face-masked staff working in a blizzard of pulverized Styrofoam into perfectly textured pieces of the dinosaur model. To complete the form, metal brackets, wooden buttresses and rare-earth magnets were used to fuse the pieces together. Finally, visible seams were covered and gaps, if any, filled in with resin, and the model was painted and rubbed with diatomaceous earth for a final, natural effect.

“One challenge was that we never saw the *Mamenchisaurus* as a whole until all the pieces were set up in our gallery during installation,” explains Michael Meister, director of exhibition design. “It’s only then that we saw the work that had taken place over the year come together.”

The finished model weighs about 800 pounds, roughly half of that accounted for by the model’s interior aluminum armature. In real life, the creature would have weighed 13 tons! Its long neck was lightened by the presence of air sacs within the vertebrae, a key feature that made such extreme anatomy possible. The model lacks this advantage so a barely visible length of aircraft cable helps secure the neck to the ceiling.

Because the model will eventually travel with the exhibition to other venues, a removable section of neck allows for an adjustment in height of the head from 15 feet down to 11 feet above the ground to accommodate lower ceilings. For the same reason, consideration was given to the ease of breaking the model down, shipping it, and reassembling it. This model will disassemble into about 30 discrete sections and arrive at each new location with a detailed instruction guide and helpful photographs for the local crews who will work under the supervision of a Museum staffer.

“All the big work was at the front end,” says Train. “It goes together like a big plastic model, like an airplane kit.”

As for nicks or scratches that happen along the way? The model comes with its own touch-up kit, too. 🛠️

Illustrations on pages 6-7 and 8-9 © AMNH/Hall Train

**Members-only Preview
Friday, April 15**

Members are invited to see the *The World’s Largest Dinosaurs* at a special preview on Friday, April 15, beginning at 4 pm. See the show and stay for a wine reception from 6 to 8 pm. Don’t forget to RSVP by calling the Membership office at 212-769-5606 by April 6.

Credits
The World’s Largest Dinosaurs is organized by the American Museum of Natural History, New York (www.amnh.org) in collaboration with Coolture Marketing, Bogotá, Colombia.

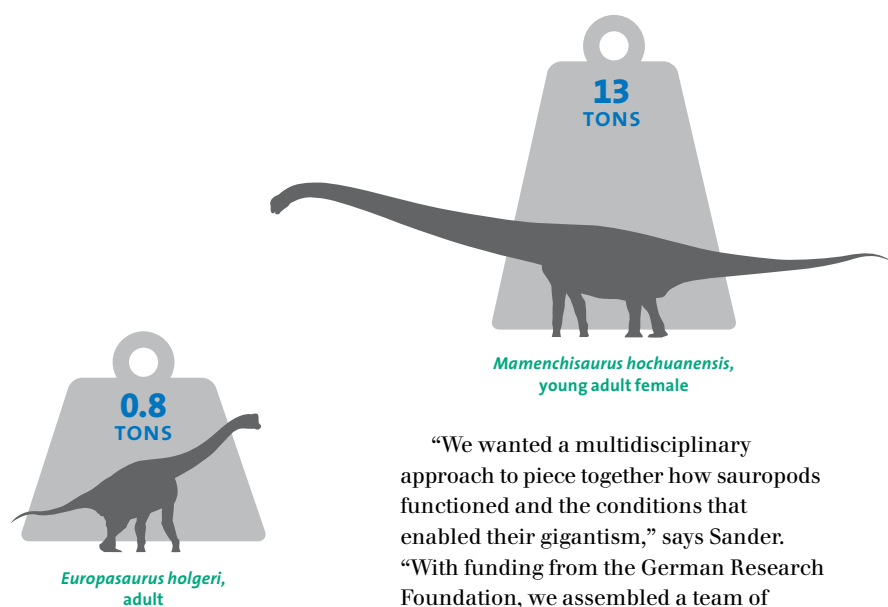
The World’s Largest Dinosaurs is proudly supported by Bank of America.

Additional support is generously provided by Marshall P. and Rachael C. Levine Drs. Harlan B. and Natasha Levine

Biology of Sauropod Dinosaurs: Understanding the Life of Giants, edited by Nicole Klein, Kristian Remes, Carole T. Gee, and P. Martin Sander, guest co-curator of The World’s Largest Dinosaurs, will be available from the Museum Shop.

Living Large

HOW DID SAUROPODS GET SO BIG?



since 1905. Sauropods maxed out in size with *Argentinosaurus*, an animal that perhaps weighed up to 90 tons, or as much as 18 adult male African elephants.

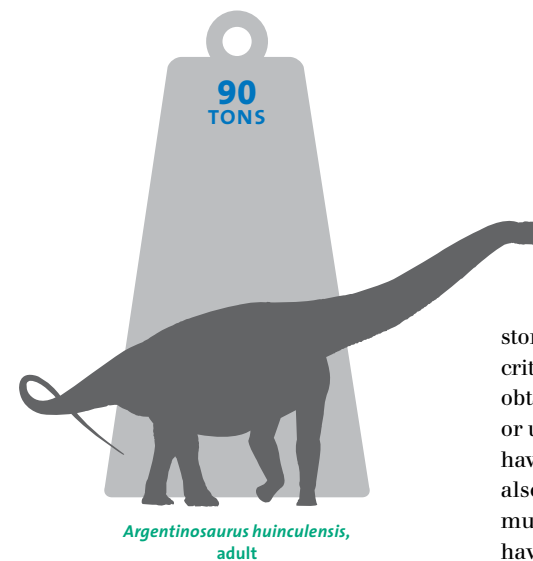
In size and stature, sauropods are unmatched. Scientists have long been mystified by these titanic proportions. How could these colossal animals have eaten enough food to survive? Was their size related to lower atmospheric oxygen during the Triassic and Jurassic? Was their bone constructed differently on a microscopic level to allow for such scale?

New research under the direction of Martin Sander of Bonn University in Germany is beginning to answer these questions and to uncover the circumstances that allowed titans to exist. The answer seems to lie in sauropods' biology rather than in the characteristics of their environment.

"We wanted a multidisciplinary approach to piece together how sauropods functioned and the conditions that enabled their gigantism," says Sander. "With funding from the German Research Foundation, we assembled a team of 35 to 40 people, of which paleontologists have been the minority. There are animal nutritionists, medical physiologists, even experts in materials science who are seeing if the bone structure is unusual."

This research—work that provides the framework for the Museum's new exhibition, *The World's Largest Dinosaurs*, of which Sander is a guest co-curator—has led to a better understanding of what would have allowed these titans to evolve to and live at their astounding size.

"Martin's team gives us tremendous insight into the biology of sauropods," says Mark Norell, chair of the Division of Paleontology at the Museum and curator of *The World's Largest Dinosaurs*. "We wanted to do a dinosaur exhibition steeped in current science that no one has done before, and the topic of scaling and gigantism seemed natural. People will come away with a deep understanding of these animals as they were alive."



Sauropodomorphs are members of the of dinosaur clade Saurischia, a group that includes theropods like *Tyrannosaurus rex* as well as modern birds. The earliest sauropodomorphs—the *Plateosaurus* on display on the fourth floor is an example—are found in Late Triassic sediments around the world. Like their ancestors, these dinosaurs were bipedal. But they had also lost the claws for grasping prey, had small skulls with few muscle attachments for chewing, and had reduced tooth size. The more advanced sauropods dropped onto all four limbs by the Jurassic, although the forefeet retained a hint of the ancestral condition in that they left smaller, crescent-shaped prints as evidenced by the colossal footprints preserved in the Glen Rose Trackway, also on display on the fourth floor. Numerous species populated their evolutionary tree, including slender 17-foot dwarfs adapted to European archipelagos in the Cretaceous and the swan-necked *Mamenchisaurus*, first uncovered in China during highway construction in the 1950s. Most got very, very big.

Working since 2004 to piece together the puzzle of gigantism, Sander and his colleagues have found that a unique combination of primitive and innovative traits in sauropods triggered an evolutionary cascade of feedback loops that ultimately allowed enormous proportions to evolve. These traits include swallowing and not milling food, egg laying, a lack of parental care, warm-bloodedness, long necks, and avian-like lungs.

Unlike most herbivores, sauropods did not chew their food—swallowing it whole instead—or grind it in a mill within their

stomachs. This primitive feature was critical for these enormous animals to obtain enough energy: only by not chewing or using gastroliths could sauropods have enough time to eat enough. Chewing also goes hand-in-hand with large facial muscles and heads, features that would have inhibited the development of the long necks that allowed sauropods to gather enough food because the skull would have weighed too much. Even though sauropods raked with their teeth, the food available at the time—horsetail, conifer, monkey puzzle tree, and ginkgo of the pre-flower world, a diet off-limits to vegetarian mammals because of silica and other harsh compounds—quickly wore teeth to nubs, which the group solved by replacing each tooth perhaps as quickly as every 30 days.

"Chewing food seems to limit body size evolutionarily because it makes the head heavier," says Sander. "This is what I really like about our research and the exhibition: the insights that sauropods in particular and dinosaurs in general provide about mammalian evolution. Dinosaurs become a model organism for studying the evolution of large land animals, and understanding them helps us understand the group we belong to."

Another primitive trait that facilitated large size is "lay and leave" reproduction. Sauropods laid between eight and 40 eggs in each clutch, and because larger females probably had several clutches a year, Sander and colleagues argue that these dinosaurs faced a lower risk of extinction at lower population densities than large mammals. A physical limit on egg size, though, meant that the hatchlings were extremely small: imagine a large house cat next to an animal the size of *Mamenchisaurus*. Such a large size difference between parent and offspring forces the young to fend for themselves.

Interestingly, the hatchlings' small size likely led to one of the three innovations—shared, derived traits—proposed by Sander and his colleagues. Because the young had

to grow about five orders of magnitude to reach adulthood, and because this aggressive rate of growth would not be possible in a cold-blooded animal, Sander thinks that sauropods must have been warm-blooded. Modern terrestrial mammals, which independently evolved warm-bloodedness, are restrained from growing to larger sizes by their need to chew, live birth of young, and the need to get rid of excess body heat. Warm-blooded, titanic sauropods did have one of these problems: they could overheat. That's why some researchers think that sauropod metabolism probably slowed as the animals grew to adulthood.

Two other novel traits were key to sauropod gigantism. First, an extremely long neck allowed these animals to efficiently strip foodstuffs from their environment, giving them greater access to vegetation than other animals had and enabling them to "mow," or eat without moving their heavy bodies and large, columnar legs, each of which could weigh several tons. *Mamenchisaurus* probably needed to shift location about 100 times a day in order to consume the estimated 1,000 pounds of vegetation; by contrast, if a horse grazed a similar amount it would have to move 5,000 times.

Second, the birdlike lung was a necessary anatomical feature for sauropods to live at colossal size. Birds, and sauropods, maximize the volume of air that they can breathe through a special air management system consisting of air sacs—some of which invade bones—in their body cavity. Bone pneumatized with air pockets created a trait that sauropods could exploit: the lightening of the axial skeleton. Once the neck, backbone, ribs, and tails of sauropods were hollowed, the entire animal was lightened for its size and necks could stretch to unusual lengths. As a result, the evolution of bigger sauropods was encouraged in a loop of evolutionary feedback.

"The avian lung is crucial for gigantism," says Sander. "An animal cannot have a long neck and a long windpipe with a mammalian lung because of the so-called dead space problem: if the volume of air contained in the windpipe is larger than the volume of the lung, the animal cannot breathe. But the avian lung with its huge air sacs has greater volume than the longest sauropod windpipe."

Call it the bearable lightness of being.

RESEARCH FROM THE MUSEUM: Two SAUROPOD STUDIES

Analyzing the finer details of gargantuan sauropods is not an easy proposition. Luckily for Amy Balanoff—a graduate student working under Museum Curator Mark Norell who is interested in the neuroanatomy of dinosaurs—*Apatosaurus* brains were the size of an orange and the larger braincase could easily fit into an industrial CT scanner. And when Norell, along with Daniel Ksepka of North Carolina State University, described the leg, shoulder, and neck of *Erketu ellisoni*, a sauropod species discovered during surveys of the Gobi, they could handle the large but fragile fossils because of expert preparation by Museum staff. Both projects were published last year in *American Museum Novitates*, one of the Museum’s peer-reviewed journals.

“Although the work in my lab focuses on theropod dinosaurs and the origin of birds, we have begun to branch out into other dinosaur groups as well,” says Norell. “Drawing on our vast collections and new specimens that we have collected in the Gobi Desert, we have begun to look at sauropod dinosaurs in new and different ways.”



1.

PEERING INTO APATOSAURUS’S BRAIN

The research by Balanoff and her colleagues Gabe Bever, currently at Yale University, and Takehito Ikejiri of the University of Michigan has produced the first three-dimensional reconstruction of the endocast (the cavity where the brain sits, which can be thought of as a “fossilized brain”) of a “whip tail” sauropod, or a diplodocoid, based on CT information. The specimen, a rare *Apatosaurus* braincase from western Colorado, was brought to life through 127 thin CT scan slices that allowed the team to reconstruct the brain’s outer surface and determine its shape and the position of the cranial nerves.

Their analysis confirms that *Apatosaurus*, the iconic giant found mounted on the Museum’s fourth floor, has an S-shaped brain. This appears to be a derived condition and distinguishes the species from other primitive Saurischian dinosaurs, which have more tubular brains. Balanoff and her colleagues’ careful analysis of the optic and other nerves that emanate from the brain and are visible in the endocast shows that the *Apatosaurus* brain shared many features with those of other dinosaurs but differed in important ways. For example, as in other sauropods, the pituitary section of the brain is very large. That makes sense because this part of the brain controls growth, and these dinosaurs needed to grow very rapidly to reach their colossal sizes.

“In the fossil the pituitary is so big that it can easily been seen projecting from the bottom of the endocast,” says Balanoff. “If you look at a phylogenetic tree of sauropods, you see an expansion of the pituitary as the animals get larger and need to grow quickly. You also see this over and over in vertebrates. Giant birds have a relatively large pituitary.”

But the fossil also hints to some variation in neuroanatomical traits among sauropods, which can be used to reconstruct the evolutionary relationships among these animals. Like other sauropods, *Apatosaurus* has a small opening on the top of the braincase, an opening that has been postulated to be a light-sensitive “third eye,” or pineal opening, similar to that found in many reptiles, including lizards. The size and shape of this opening, however, differs among sauropods. *Apatosaurus* is no exception. It has a single “pineal” opening as opposed to more derived sauropods which have two separate openings in this region.

Photo © AMNH/B. Blackwell

2.

DESCRIBING A NEW SAUROPOD

The second paper on sauropods is the recent description of the new species *Erketu ellisoni* by Ksepka and Norell. Named after Museum scientific illustrator Mick Ellison to acknowledge how his talent has brought many dinosaurs to life, the specimen consists of nine neck vertebrae, as well as shoulder and leg bones. The vertebrae are particularly interesting: they are so elongated and stretched that the neck of this sauropod must have been disproportionately long compared to the body.

“All sauropod vertebrae are beautiful—built like cathedrals, intricate and strong yet graceful,” says Ksepka. “They look fragile but are built to be strong and light-weight. Using the CT scanner, you can even see how the parts of the vertebrae that look solid are a honeycomb of air pockets where the pneumatic system invades the bone.”

An analysis of *Erketu* comparing its features with those of other sauropods shows that this specimen is a close relative of titanosaurs rather than a member of one of the other primary sauropod groups, “whip-tailed” diplodocoids or brachiosaurs. Titanosaurs were a diverse group that survived the longest and became global in distribution. *Erketu* provided proof that specimens from China previously defined as brachiosaurs are in fact also close relatives of titanosaurs.

“*Qiaowanlong* [a genus of sauropod dinosaur] was thought to be the only Asian brachiosaur,” says Ksepka. “But we think this is *Erketu*’s closest relative or sister taxa. Brachiosaurs seem to have never made it to Asia and were probably locked on the western side of the Turgai Sea that separated Europe and Africa from Asia.”

A second fossil found near *Erketu* but dating to the same moment in geological time suggests that a true titanosaur shared its landscape. Ksepka and Norell think that the varied physical forms of these gigantic animals indicate different adaptive strategies.

“Although sauropods are one of the most iconic dinosaur groups, they are understudied. They are difficult and expensive to collect, and their heavy skeletons make them unwieldy study specimens,” says Norell. “But using new technology, we are beginning to get a much better picture of their relationships, biology, and even behavior. This picture is still in a nascent stage, but I imagine that the next 10 years will completely change our view of these animals.”

Download issues of *American Museum Novitates* from the Museum Research Library’s website at <http://digitallibrary.amnh.org/dspace/>.



A vertebrae from a sauropod fossil found near that of *Erketu*

Photo © AMNH/M. Ellison



Become a Fossil Hunter

There are times when there is no substitute for getting your hands dirty. For paleontologists, one of the best parts of the job is spending time in the field digging for dinosaur bones.

Hoping to approximate that experience as closely as possible, the Museum’s Exhibition Department installed an interactive dig pit toward the end of the new exhibition *The World’s Largest Dinosaurs*. Here, some 30 visitors at a time will be invited to stand around a table-height trough where, with eyes protected by goggles, they can use chisels and brushes to chip away at 350 pounds of sand and wax concealing casts of huge femurs, fibulas, rib fragments, and more—frozen in place just as they would be in a matrix of rock out in the field. (At 15 feet by 11 feet, the dig pit is a much larger version of the floor-level dig that delights children in the Museum’s Discovery Room.)

Surrounding the dig pit are panels that lay out the history of Howe Quarry in Wyoming where, with the exception of a *Camarasaurus* skull, all the originals for the dig pit’s casts of *Barosaurus* and other sauropod bones were found. It was there that, in 1934, a Museum crew led by Barnum Brown, the paleontologist best known for discovering *Tyrannosaurus rex*, uncovered some 4,000 dinosaur fossils dating back 155 million years. Another member of the team, Roland T. Bird, drew a large-scale diagram of exactly where fossils from at least 25 dinosaurs were found and that too is on display, with a challenge to visitors to locate and identify specific fossils. So rich was the area, Brown himself dubbed it “an absolute, knockout dinosaur treasure trove!”

And so, visitors will find, is the dig pit.

Programs and Events

For more programs and to purchase tickets, visit amnh.org/calendar.

APRIL

Spring Bird Walks In Central Park

Begin Tuesday, April 5
Visit amnh.org for details
\$85

Observe the spring migration of birds in Central Park in this eight-week series on Tuesday, Wednesday, Thursday, or Friday mornings.

The Size and Age of the Universe

Tuesday, April 5
7 pm
\$13.50 Members
Wendy Freedman will describe how astronomer Edwin Hubble discovered galaxies and the expansion of the universe.

SciCafe
Wednesday, April 6
Wednesday, May 4
Wednesday, June 1
Doors open at 7 pm
Free admission, cash bar 21+ with ID
An informal evening of science, cocktails, and conversation. Visit amnh.org/scicafe for details.

Behind the Scenes in Herpetology

Thursday, April 7
6:30–8 pm
7–8:30 pm
7:30–9 pm
\$35
Join a guided tour of the Museum’s research collections of reptiles and amphibians.

Members-only Highlights Tour
Sunday, April 10
Saturday, May 14
Sunday, June 12
3–4:30 pm
Free (Registration required; call 212-769-5200)
Join a Museum guide for an insider’s introduction to all the Museum has to offer.

A Hitchhiker’s Guide to Habitable Planets in Our Galaxy
Monday, April 11
7:30 pm
\$13.50 Members
MIT Professor Linda Elkins-Tanton will discuss planetary formation and what is needed to encourage development of life.

Science Sense Tour: Minerals and Gems

Wednesday, April 13
2:30 pm
Free (Registration required; call 212-313-7565)
A special tour for visitors who are blind or partially sighted.

A Night at the Museum Sleepover

Saturday, April 16
Friday, June 17
Saturday, June 25
Members’ price is \$119 per person
This unique after-hours experience will thrill kids ages 7 to 13 and their caregivers.

One Step Beyond
Friday, April 22
Friday, May 20
9 pm–1 am
\$25
21+ with ID
Enjoy drinks and dancing in the Rose Center for Earth and Space and a complimentary screening of a Space Show.

Annual IRIS Lecture: Scientific and Humanitarian Aspects of the 2010 Haiti Earthquake

Monday, April 25
6:30 pm
Free
Dr. Wayne D. Pennington of Michigan Technological University will discuss the 2010 Haiti earthquake and relief and reconstruction efforts.

Exoplanets Revealed
Tuesday, April 26
6:30 pm
Members’ tickets are \$13.50
Emily Rice leads a program about extrasolar planets.

Tickets

Tickets are available by phone at 212-769-5200, Monday–Friday, 9 am–5 pm, or by visiting amnh.org. Please have your Membership number ready.

Please be aware that ticket sales are final for all Members’ programs. All programs go ahead rain or shine. There are no refunds unless the program is cancelled by the Museum.

Exhibitions and Attractions

Admission is by timed entry only.

The World’s Largest Dinosaurs

Opens Saturday, April 16
Free for Members
This exciting exhibition features cutting-edge research about super-sized sauropods and offers new insights into how their colossal bodies functioned.

Brain: The Inside Story
Through Sunday, August 14
Free for Members
Step into the amazing, changing brain! This exhibition explores how the brain—a product of millions of years of evolution—produces and processes thoughts, senses, and feelings.

The Butterfly Conservatory
Through Monday, May 30
Members’ tickets are \$12 adults, \$7.50 children
This annual favorite features up to 500 live, free-flying tropical butterflies housed in a vivarium that approximates their natural habitat.

MAY

Adventures in the Global Kitchen: Rooftop Farming
Wednesday, April 27
6:30 pm
\$25
Brooklyn farmers discuss city agriculture with tastings of rooftop-grown produce.

Global Weekends Island Beats: Festival of Oceania

Saturday, April 30
Noon–5 pm
Free
A family-friendly program about Pacific Island cultures with performances and more.

A Visit to an Anthracite Coal Mine

Saturday, April 30
9 am–5 pm
\$90
Join geologist Sidney Horenstein on a trip into the Pioneer Tunnel Coal Mine in Ashland, Pennsylvania.

Human Evolution and Why It Matters: A Conversation with Leakey and Johanson

Thursday, May 5
6:30 pm
\$25
Paleoanthropologists Richard Leakey and Donald Johanson will share the stage to discuss the overwhelming evidence for evolution in the hominid fossil record and why evolutionary history matters.

Physics of the Future with Michio Kaku

Monday, May 9
7:30 pm
\$13.50 Members
Michio Kaku, author of *Physics of the Impossible*, will discuss his forecasts of scientific leaps.

Adventures in the Global Kitchen: Urban Beekeeping

Wednesday, May 11
6:30 pm
\$25
Learn about urban beekeeping and taste local honey.

Explore the Great Swamp
Saturday, May 14
9 am–4 pm
\$90
(Includes transportation by private coach; bring your lunch)
Please register by April 28
Ornithologist Paul Sweet and herpetologist David Kizirian lead a trip to New Jersey’s Great Swamp Refuge, which consists of 7,600 acres of varied habitats.

What’s What Hall Tour

Sunday, May 15
3–4:30 pm
Free (Registration required; call 212-769-5200)
Join a Museum tour guide for this “what’s what?” tour, recommended for kids age 6 to 11 with a parent or guardian.

Milstein Science Series:

Living Large
Sunday, May 15
Noon–4 pm
Free
Meet scientists at this program about the biology of being big.

From East to West on 155th Street
Saturday, May 21
10 am–noon
1–3 pm
\$30
Geologist Sidney Horenstein leads this walking tour along 155th Street about geology’s influence on the city layout.

Behind the Scenes in the Center for Biodiversity and Conservation

Tuesday, May 24
6:30–8pm
7–8:30 pm
7:30–9 pm
\$35
Join four scientists from the Museum’s Center for Biodiversity and Conservation (CBC) for a look at their work in biodiversity-rich regions.

The Great Sperm Whale

Wednesday, May 25
6:30–8 pm
\$12 Members
Enter at 77th Street
Richard Ellis will discuss his new book, *The Great Sperm Whale*.

Frogs: A Chorus of Colors
Opens Saturday, May 28
Members’ tickets are \$12 adults, \$7.50 children
This popular exhibition introduces visitors to the colorful and richly diverse world of frogs.

Sea Rex: Journey to a Prehistoric World
Through June 30
Members’ tickets are \$12 adults, \$7.50 children
Travel from a modern-day aquarium to the Triassic, Jurassic, and Cretaceous periods to discover an amazing underwater universe.

Hayden Planetarium Space Show
Journey to the Stars
Members’ tickets are \$12 adults, \$7.50 children
Journey to the Stars launches viewers through time and space to experience the life and death of the stars in our night sky.

Credits
Brain: The Inside Story is organized by the American Museum of Natural History, New York, (www.amnh.org) in collaboration with Codice. Idee per la cultura, Torino, Italy in association with Comune di Milano - Assessorato Cultura, Italy; Guangdong Science Center, Guangzhou, China; and Parque de las Ciencias, Granada, Spain.

The Mighty Behemoths
Tuesday, May 31
6:30
Members’ tickets are **\$13.50**
Ted Williams and **Brian Abbott** search out the giants of our solar system.

JUNE

Identification Day
Saturday, June 4
Afternoon
Free
Museum scientists will attempt to identify visitors’ shells, bones, and more. In conjunction with *The World’s Largest Dinosaurs*, some of the largest specimens from Museum collections will be on display.

Fountaineering
Saturday, June 11
10 am–noon
1–3 pm
\$30
Sidney Horenstein leads this tour of the city’s fountains, with a focus on geological and historical facts.

Field Trip to the Moon
Wednesday, June 15
6 pm
Members’ tickets are **\$12** adults, **\$7.50** children
Feel the ground shake as your rocket launches and see a sunrise in space.

Fun with Fossils
Saturday, June 18
9 am–4 pm
\$85 (Includes transportation by private coach; bring your lunch)
Division of Paleontology’s **Carl Mehling** leads an expedition to Big Brook, New Jersey, to collect fossils.

Summer Solstice Sail
Tuesday, June 21
8–10 pm
\$95 (Space is limited to 34)
Set sail with astrophysicist **Charles Liu** to watch the sun set on the longest day of the year.

JULY

Great Gull Island Research Project
Thursday, July 21
8 am–7 pm
\$120 (Includes transportation by private coach; bring your lunch)
Spend a day on Great Gull Island, a Museum research station in Long Island Sound, with ornithologist **Helen Hays** to watch hatching chicks, track nests, and explore the island.

Credits
Public programs are made possible, in part, by the Rita and Frits Markus Fund for the Public Understanding of Science.

Milstein Science Series is proudly sponsored by the Paul and Irma Milstein Family.

Island Beats: Festival of Oceania is co-presented with the Australian Consulate-General, the New Zealand Consulate General, the NGO Committee on the International Decade of the World’s Indigenous Peoples, and Ha-la-wai.

Support for Global Weekends is made possible, in part, by the Ford Foundation, the May and Samuel Rudin Family Foundation, Inc., the Tolan Family, and the family of Frederick H. Leonhardt.

SciCafe is proudly sponsored by Judy and Josh Weston.

SciCafe is made possible in part by a Science Education Partnership Award (SEPA) grant from the National Center for Research Resources (NCRR), a component of the National Institutes of Health (NIH).

Popular Science is the media partner for Hayden Planetarium monthly astronomy programs and lectures.

*The Museum’s Youth Initiatives programming is generously supported by the leadership contribution of the **New York Life Foundation**.*

Generous support for Brain: The Inside Story has been provided by The Eileen P. Bernard Exhibition Fund, Virginia Hearst Randt and Dana Randt, The Mortimer D. Sackler Foundation, Inc., and Mary and David Solomon.

*Additional support for Brain: The Inside Story and its related educational programming has been provided by **Roche**.*

*The Presenting Sponsor of The Butterfly Conservatory is **ConEdison**.*

Journey to the Stars was produced by the American Museum of Natural History, the Rose Center for Earth and Space, and the Hayden Planetarium.

Journey to the Stars was developed by the American Museum of Natural History, New York in collaboration with the California Academy of Sciences, San Francisco; GOTO INC, Tokyo, Japan; Papalote Museo del Niño, Mexico City, Mexico and Smithsonian National Air and Space Museum, Washington, D.C.

*Journey to the Stars was created by the American Museum of Natural History, with the major support and partnership of **NASA**, Science Mission Directorate, Heliophysics Division.*

*Made possible through the generous sponsorship of **Lockheed Martin**.*

*And proudly sponsored by **Accenture**.*

Supercomputing resources provided by the Texas Advanced Computing Center (TACC) at The University of Texas at Austin, through the TeraGrid, a project of the National Science Foundation.

APRIL

05
Tuesday
The Size and Age of the Universe

Spring Bird Walks begin

06
Wednesday
SciCafe

07
Thursday
Behind the Scenes in Herpetology

10
Sunday
Members-only Highlights Tour

11
Monday
A Hitchhiker’s Guide to Habitable Planets

13
Wednesday
Science Sense Tour: Minerals and Gems

15
Friday
Members-only preview of *The World’s Largest Dinosaurs*

16
Saturday
***The World’s Largest Dinosaurs** opens*

A Night at the Museum Sleepover

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Friday
One Step Beyond

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Monday
Annual IRIS Lecture

A Visit to an Anthracite Coal Mine

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Tuesday
Exoplanets Revealed

27
Wednesday
Adventures in the Global Kitchen: Rooftop Farming

30
Saturday
Global Weekends
Island Beats: Festival of Oceania

MAY

04
Wednesday
SciCafe

05
Thursday
Human Evolution and Why It Matters: A Conversation with Leakey and Johanson

09
Monday
Physics of the Future with Michio Kaku

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The Great Sperm Whale

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Saturday
***Frogs: A Chorus of Colors** opens*

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The Mighty Behemoths

JUNE AND BEYOND

01
Wednesday
SciCafe

04
Saturday
Identification Day

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Saturday
Fountaineering

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Sunday
Members-only Highlights Tour

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Field Trip to the Moon

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Friday
A Night at the Museum Sleepover

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Saturday
Fun with Fossils

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Tuesday
Summer Solstice Sail

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Saturday
A Night at the Museum Sleepover

JULY

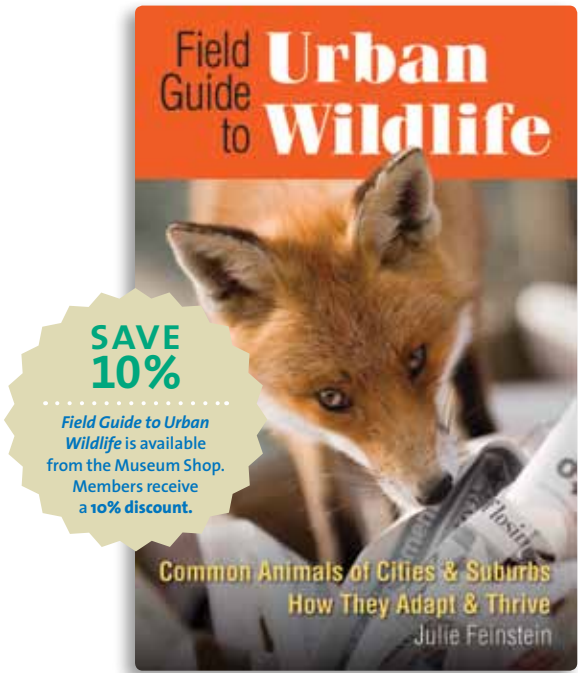
21
Thursday
Great Gull Island Research Project

Summer Camps at the Museum

Adventures in Science camps for children entering grades 2 through 7 include Astrophysics, Fossils and DNA, Frogs, Titans: The World’s Largest Dinosaurs, and Brain.

Five- and three-day sessions are offered beginning June 27. For more information, call 212-313-7893.

A Guide to the City’s Wildest Residents



Like many New Yorkers, Julie Feinstein often spots various nonhuman creatures on her daily commute to work as collections manager of the Museum’s Ambrose Monell Collection for Molecular and Microbial Research, a repository of frozen tissue specimens that serves to preserve a record of biodiversity for research by scientists at the Museum and around the world. Now Feinstein has written a book to highlight an often-overlooked type of biodiversity: her *Field Guide to Urban Wildlife* offers accounts of 135 species of mammals, birds, and insects commonly found in North American cities, including these animals’ adaptations to city ecosystems and their relationships with the humans who share their habitat. The excerpts below introduce this first-of-a-kind guide and a snapshot of one of the city’s largest wild carnivores.

For many urban animals, association with humans goes way beyond tolerance; they thrive on their interactions with us, and they live in cities because we do.

New York City House Sparrows fly down to underground subway platforms to snack on fallen potato chips. Pigeons barely step aside to let pedestrians pass. Crows open dropped ketchup packages to eat the contents and they wash that

down with leftover milk from the bottoms of discarded cartons. The animals, birds, and insects that coinhabit our cities have come a long way from the forests and plains of their ancestors. For many urban animals, association with humans goes way beyond tolerance; they thrive on their interactions with us and they live in cities because we do.

Though urban animals live among us, sometimes even inside our homes, they largely go unnoticed. They are too commonplace. Yet there are moments—watching a fox in the backyard, discovering a centipede in the bathtub, or finding a bat asleep in the garage—when we wonder about them.

There are numerous field guides available to help you identify the migratory birds that pass through urban parks during spring and fall. There are keys to help identify every obscure butterfly that a diligent searcher might find. But few guides focus on the commonplace. On a typical day, a city-dweller might encounter several dozen birds, five or six mammals, and many provocative insects. To find information about them we need three or four field guides, and even then we learn little beyond names and physical appearance. This guide goes beyond. It looks traditional, with photos and species accounts, but the fields through which you will be guided are backyards, city parks, basements, kitchen cabinets and bathroom drains...

Field Guide to Urban Wildlife includes entries on such metropolitan mammals as the red fox, striped skunk, raccoon, and, of course, the city coyote.

In precolonial times, coyotes were found only in the Southwest, roaming over open country and howling at the moon. Time passed. In 2007, a coyote walked into a sandwich shop in crowded downtown Chicago, climbed into a cold drink case, and settled down for a rest, surprising even blasé city-dwellers. After forty minutes of excitement, animal control officers removed the coyote and released it in a more appropriate place. Elsewhere in Chicago, coyotes interfere with traffic at O’Hare airport and occasionally must be removed to clear the runways. (According to the Federal Aviation Administration, there were about two hundred coyote-airplane collisions across the United States between 1990 and 2005.) A recent study of Chicago’s coyotes estimated that a few thousand might live there, in habitats from parks to industrial areas and residential neighborhoods. In New York State, coyotes went from first reports in the 1920s to a current population of twenty to thirty thousand. The New York coyotes make occasional forays into New York City; police, photographers, coyote-supporters, curious observers, and the news media chased a coyote around Central Park for days in 2006. New Yorkers were intrigued and followed the coyote’s exploits closely. Coyote sightings have become common in Los Angeles, Washington DC, Phoenix, Denver, and other American cities.

Reprinted with permission from *Field Guide to Urban Wildlife*
© 2011 by Julie Feinstein, Stackpole Books.

Photo courtesy of Stackpole Books

For Budding Scientists, a Space to Discover

There is a special buzz coming from a two-story enclave on the southern side of the Museum. A group of young “paleontologists” and their parents are assembling a life-sized cast skeleton of *Prestosuchus*, a 14-foot-long reptile from the late Triassic. A few younger visitors are standing underneath a Kwakiutl killer whale mask, tugging on the ropes that open and close its jaws. A replica of a baobab tree, its branches filled with birds, reptiles, and small mammals, provides an impressive backdrop to this lively scene. It’s another busy day in the Museum’s Discovery Room, which celebrates its 10th anniversary this year.

Established as the Museum’s center for hands-on scientific exploration, the Discovery Room welcomes about 115,000 visitors each year. There’s something for would-be scientists of all ages to see, learn, and, most importantly, touch in this interactive space: live animals, artifacts and, for ages 8 and up, an upper level with a seismograph and microscopes to peer at beetles, pond water from Central Park, and more. “We love the Discovery Room,” one New York City parent of a three-year-old girl recently shared with the Discovery Room staff. “The displays are set up so that exploration is totally natural to the kids. And even though we visit often, there is always something new to discover or some new facet to explore.”

In addition to serving as a place for hands-on learning, the Discovery Room also acts as a gateway to the rest of the Museum through several key programs. One such initiative, run in partnership with the nonprofit educational organization Learning through an Expanded Arts Program, annually brings more than 40 K-2nd grade classes from New York City public schools to the Museum for a lesson by a Museum educator, followed by a visit to the fourth-floor Fossil Halls. “Our goal is to inspire wonder, inspire connection, and then to take that wonder out into the rest of the Museum,” says Discovery Room Manager Daniel Zeiger.

Monday mornings in the Discovery Room are reserved for children between the ages of two-and-a-half and five, who are invited to take part in Gateway Storytime. During each session, children scamper to their favorite areas, which might be the “Curate Your Own Collection” specimen drawers or the books and puzzles that cover the carpet. They then sit for story time, which highlights anthropological or natural science themes and concludes with a trip to a related Museum hall.

For many longtime visitors, the highlight of a trip to the



The Discovery Room welcomes about 115,00 visitors each year.

Discovery Room is its monthly Meet the Scientist program, which offers a unique opportunity to interact with Museum scientists like Emily Rice, an astrophysicist who recently described her research on brown dwarfs. “Meet the Scientist has been a tremendous experience for us,” writes one parent of 10-year-old boys. “It is a big deal for the kids to meet real scientists, and it is inspiring for both the kids and parents to have the opportunity to hear from people who are scholars in their respective fields.”

The Discovery Room has achieved much in its first decade, and Zeiger, who has been with the program since 2005, has even greater plans for the future. “We will continue to build activities and programs to support the Museum’s goals and evaluate the ways in which our work enriches the lives and educational experiences of our visitors,” he says. “We will be working with parents, students, teachers, museum educators, researchers, evaluators and anyone else curious enough to explore with us.”

The Discovery Room was made possible by a grant from the Edward John Noble Foundation.



Photos © AMNH/R. Mickens

Visiting the Discovery Room

Free passes for 40-minute sessions are distributed at the Discovery Room entrance on the first floor. Availability may be limited due to room size.

Hours
School Year
(day after Labor Day–June 30):
Monday–Thursday, 1:30–5:10 pm;
Saturday–Sunday and public
school holidays, 10:30 am–1:30 pm
and 2:15–5:10 pm
Summer (July 1–Labor Day):
Monday–Sunday, 10:30 am–1:30 pm
and 2:15–5:10 pm

Gateway Storytime takes place on Monday mornings during the school year, beginning after Labor Day at 10:15 and 11 am. Free passes are distributed at the Discovery Room entrance before each session. Availability may be limited.

Fossil Hunting On Vacation



Head out on a fossil dig with the Museum.

For her eighth birthday, Alexandra Wong got a surprise present she had been wishing for: a week of hunting for fossils in Colorado with AMNH Expeditions’ summer program *Digging for Dinosaurs: A Colorado Family Adventure*. Along with her parents, Museum Members Kim Hanna and Paul Wong, and several other adventurous families, Alexandra spent her vacation learning about paleontology from the ground up: how to recognize fossils, how to collect them, and how to clean and prepare them for study. It was, she declares, “The best trip ever.”

Alexandra is a regular at Museum camps and programs. Says Kim Hanna: “She really lights up at the Museum. It’s a fabulous place to learn. It helps children learn to observe and

interpret what they see, with real scientists right there to answer questions.” But her birthday trip was an entirely different experience: a chance to learn from a Museum scientist in the field.

Led by Carl Mehling, who oversees the Museum’s dinosaur fossil collection, and local paleontologist Jonathan Cooley, *Digging for Dinosaurs: A Colorado Family Adventure* took 10 young participants and their parents on a search for fossils in western Colorado. The group made rubbings of dinosaur tracks, joined in a quarry dig for dinosaur and plant fossils, and visited a fossil lab where they learned to make casts of bones and teeth.

“It’s a walk through all aspects of paleontology,” says Mehling. “People in the program see how much work and care is behind the study of fossils, and they learn side by side in the field with working paleontologists.”

The Hanna-Wong family have fond memories of their one-of-a-kind summer trip. “An expedition like this is a science class, a vacation, and an adventure, with family togetherness and the opportunity to meet other people who like to spend time with their kids doing interesting things,” says Kim Hanna.

After returning from Colorado, Mehling led Alexandra and other students on behind-the-scenes tours of the Museum’s fossil collection, ending in the Big Bone Room with its collection of awe-inspiring giant fossils—including the 650-pound thigh bone of the long-necked, plant-eating *Camarasaurus*, which will be on display in the new exhibition *The World’s Largest Dinosaurs*.

For more information, visit amnhexpeditions.org.

Travel with the Museum in 2011

Upcoming paleontology trips include:

Digging for Dinosaurs: A Colorado Family Adventure with Jack Conrad, June 25–July 2 and with Carl Mehling, July 2–8

In addition to fossil-hunting, these week-long vacations include horseback riding, picnics, a rodeo, and an all-day rafting trip on the Colorado River.

Mongolia: In the Footsteps of Roy Chapman Andrews with Amy Balanoff, August 10–22

Led by paleontologist Amy Balanoff, this tour includes a visit to Flaming Cliffs, where explorer Roy Chapman Andrews discovered the first dinosaur eggs.



Photos courtesy of Carl Mehling

Reminders for Members

Members’ Breakfast
Thursday, June 9
7:30 to 9:30 am
For Contributor and Higher-level Members
Kindly RSVP to the Membership Office by calling 212-769-5606

Enjoy breakfast with the dinosaurs in the Museum’s fossil halls, then see *The World’s Largest Dinosaurs* and *Frogs: A Chorus of Colors*.

Discovery Night for New Members
Thursday, June 16
6 to 8 pm
Kindly RSVP to the Membership Office by calling 212-769-5606

Meet fellow Members and explore the Museum’s fossil halls during Members-only evening hours.

Don’t Miss

Fun With Fossils
Saturday, June 18
9 am–4 pm
\$85 (Includes transportation by private coach)

Pack your lunch and collecting bag and join Carl Mehling for an expedition to Big Brook, New Jersey, to collect invertebrate and vertebrate fossils from the late Cretaceous period.

Great Gull Island Research Project
Thursday, July 21
8 am–7 pm
\$120 (Includes transportation by private coach; bring your lunch)

Spend a day on Great Gull Island, a Museum research station in Long Island Sound, with ornithologist Helen Hays to watch hatching chicks, track nests, and explore the island.

Written in Stone

When the Museum embarked on a recent renovation of the familiar “castle” complex on the 77th Street, the project managers discovered that hundreds of the façade’s 54,000 pink-to-red granite stones were damaged and in need of repair. After an exhaustive search for material of the same color and texture, granite was obtained from a half dozen sources, including a closed quarry on Picton Island in upstate New York—a quarry that had actually supplied granite for original Museum buildings. But that, in a story worthy of a Victorian dynastic drama, is just the beginning of the connection.

In the 1890s, the Museum, fast outgrowing its first building on the current site, undertook a massive expansion along the Museum’s south side between Columbus Avenue and Central Park West. Around the same time, a wood-frame house was being built at the southern end of Picton Island. Fast forward to 1933, when, in the depths of the Great Depression, Bernard “Barney” Heineman of New York City bought that house and its grounds for \$1,600, according to family members, and much of the rest of the island, including the quarry, for \$456 in back taxes.

This private island in the St. Lawrence River, one of the famed Thousand Islands and reachable only by boat from Clayton, N.Y., was to become a summer haven for generations of Heinemans: Barney and his wife Lucy Morgenthau Heineman, their three sons, their six grandchildren, and their children.

When, in the course of the recent renovation, the family was contacted about the purchase of \$56,000 worth of Picton Island granite, the answer was swift and simple: the family would donate it.

When the family was contacted about the Picton Island granite, the answer was simple: they would donate it.

That’s because their beloved grandfather Barney, who had parlayed a 10th-grade education into running one of the largest textile brokerage companies in the country, wasn’t just a businessman. He was also an amateur lepidopterist who had been donating specimens to the Museum since 1927. A subspecies described by F. Martin Brown, with whom he coauthored *Jamaica and its Butterflies*, bears his name: *Coenonympha nipisiquit heinemani*.

“He was an old-fashioned 19th-century man,” says his granddaughter Deborah Heineman of Chappaqua, N.Y. “The kind who walked around in his hobnailed boots and tapped on things.”

Sidney Horenstein, geologist and educator emeritus for the Museum who has made a life’s work of tracking down the origin of the Museum’s building stones, met Barney Heineman just months before his death in 1979. While on a family vacation upstate, Horenstein contacted Heineman in hopes of seeing the quarry and another that had supplied Museum granite on nearby Grindstone Island. Heineman, after insisting on a spirited game of backgammon, made his vintage launch and

its pilot available to Horenstein and his wife and children for the afternoon. “He was delighted that I was there and that I was from the Museum,” says Horenstein.

In another twist, Deborah says her parents might never have met if not for the Museum. Her father, Bernard Jr., known to his family as Jack, was bitten by the collecting bug too, and in 1952 he went on an expedition to Ceylon in search of butterflies for what was then the Museum’s Department of Insects and Spiders. While abroad, he met a young social worker named Ruth Kress. They married in 1953, and in 1954, Deborah was born.

Deborah says the family had bragged about the quarry as a source of Museum granite, but visitors were skeptical. “Now,” she says, “They believe us!”



Members of the Heineman family: Ben and Nick Scaglione, Deborah Heineman, Kay Heineman, Bob Calabretta, and Tom Heineman.



1. Actor Susan Sarandon and Curator Rob DeSalle (center) shared the stage at "This Is Your Brain on Ping Pong" on January 19.
2. Table tennis enthusiasts filled Milstein Hall of Ocean Life on January 19.

3. At the Museum's first-ever tweetup on January 12, tweeters viewed *Brain: The Inside Story*.
4. The December 12 Members' Holiday Party featured face-painting, music, and more.
5. The January 12 Brain Tweetup included behind-the-scenes tours of Museum collections.

6. Monks from Drepung Loseling Monastery performed a traditional opening ceremony before beginning a "Medicine Buddha" sand mandala in the Hall of Birds of the World on January 25.

Photos © AMNH/R. Mickens



1. On December 7, the Junior Council held a private viewing of *Brain: The Inside Story*.
2. Junior Council Steering Committee members Luca Mihaly and Natalie Smith enjoyed the exhibition.

3. Jesup Society members Ed Schmidt, Pat Saigo, and Carl Zydney attended a reception in the Hall of Mexico and Central America.
4. Alexandra Murata and Ivan Kotchetkov stopped by the December 7 Junior Council reception in the Hall of Saurischian Dinosaurs.

Save the Date! Upcoming Events at the Museum



APRIL

4/15 Members will have the first chance to see the exciting new exhibition *The World's Largest Dinosaurs* at this exclusive preview. Free for Members.

4/16 *The World's Largest Dinosaurs* opens to the public.



4/28 Dance the night away at the annual **Museum Dance**, the social event of the season.

MAY

5/12 The Museum holds its annual **Corporate Dinner**.

5/28 *Frogs: A Chorus of Colors* returns with more than 200 live frogs representing 25 species from Argentina to Vietnam.

JUNE

6/4 Museum scientists will attempt to identify visitors' mystery finds at Identification Day. In conjunction with *The World's Largest Dinosaurs*, large specimens and artifacts from the Museum's collections will also be on display. Free.

6/7 Jesup Society members are invited to take a guided tour of *The World's Largest Dinosaurs* and attend a reception. For more information about the Jesup Society, please call 212-769-5119.



6/15 Get an astronaut's view of a sunrise from space on **Field Trip to the Moon**, a virtual trip guided by a live presenter.

6/23 Junior Council members and guests are invited to hear about current Museum expeditions from Museum scientists, then toast the summer with cocktails on the Arthur Ross Terrace. Please call 212-769-5256 for more information about the Junior Council.

Photos 1, 2, and 4 © AMNH/R. Mickens; photo 3 © AMNH/D. Finnin

Central Park West at 79th Street
New York, New York 10024-5192
amnh.org



The World's Largest Dinosaurs opens April 16. This cover features a working drawing of the life-sized model of a young adult female *Mamenchisaurus hochuanensis* at the center of the exhibition, set against illustrations of gingko, cycad, and fern, plants known to exist at the same time as sauropods.

General Information

HOURS

Museum: Open daily, 10 am–5:45 pm;
closed on Thanksgiving and Christmas.

ENTRANCES

During Museum hours, Members may
enter at Central Park West at 79th Street
(second floor), the Rose Center/81st Street,
and through the subway (lower level).

RESTAURANTS

Museum Food Court, Café on One,
Starlight Café, and Café on 4 offer
Members a 15% discount. Hours are
subject to change.




MUSEUM SHOPS

The Museum Shop, DinoStore,
The Shop for Earth & Space,
Cosmic Shop, Brain Shop, and
Online Shop (amnhshop.com) offer
Members a 10% discount.

PHONE NUMBERS

Central Reservations 212-769-5200
Membership Office 212-769-5606
Museum Information 212-769-5100
Development 212-769-5151

TRANSPORTATION AND PARKING

Subway:  (weekdays) or  to 81st Street;
 to 79th Street, walk east to Museum
Bus: M7, M10, M11, or M104 to 79th Street;
M79 to Central Park West
Parking Garage: Open daily, 8 am–11 pm;
enter from West 81st Street. Members receive
a discounted rate of \$10 if entering after
4 pm. To receive this rate, you must show
your membership card or event ticket when
exiting the garage.