

 AMERICAN MUSEUM OF NATURAL HISTORY

ROTUNDA

Member Magazine
Spring 2016 Vol. 41 No. 2



The
CROCS
Are
COMING

NEW EXHIBIT OPENS MAY 28



**THE STORY BEHIND
THE TITANOSAUR**

From the President

Ellen V. Futter



Infectious disease and human health are among the most promising and pressing challenges for science in the 21st century. What many people don't know is that the Museum's research enterprise increasingly embraces leading-edge microbiological work related to human health—whether that means unraveling the evolution of key pathogens, examining the symbiosis between microbes and their hosts, or exploring other ecological questions related to disease and health.

This work is then brought to our visitors through such topical presentations as our current exhibition *The Secret World Inside You*, which explores the human microbiome—the trillions of microbes living on, in, and around the human body, and one of the most fascinating and promising new frontiers in medicine. The exhibition combines the Museum's work in microbiology with its deep expertise in demystifying complex topics to create a truly

groundbreaking and highly interactive exhibition. Also currently on view is *Countdown to Zero*, presented in conjunction with The Carter Center in Atlanta, about global efforts to eradicate diseases, including the amazingly successful campaign against Guinea worm.

This year, the Museum also is presenting an array of special programs related to human health, including casual evenings in our popular SciCafe series on such topics as whether the "paleo" diet is historically accurate.

And this April, we are proud to present a discussion with Dr. Margaret Hamburg, former commissioner of the Food and Drug Administration and a Museum Trustee, on the intersection between the environment and human health as this year's Environmental Lecture and Luncheon benefit. Please join us for this special event, and any of the related programs and exhibitions on view at the Museum this spring.

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ROTUNDA

American Museum of Natural History
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Design Hinterland, www.hinterlandstudio.com

ISSN 0194-6110
USPS Permit #472-650
Volume 41, No. 2, SPRING 2016
Rotunda is published quarterly by the Membership Office of the American Museum of Natural History, 15 West 77th Street, New York, NY 10024-5192. Phone: 212-769-5606. Website: amnh.org. Museum membership of \$75 per year and higher includes a subscription to *Rotunda*. © 2016 American Museum of Natural History. Periodical postage paid at New York, NY and at additional mailing offices. Postmaster: please send address changes to *Rotunda*, Membership Office, AMNH, at the above address.

Please send questions, ideas, and feedback to rotunda@amnh.org.

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A Conversation About Public Health with Former FDA Commissioner Margaret Hamburg



Noted public health expert Dr. Margaret Hamburg headlines this year's ELL event.

Pressing issues of human health will take center stage at the Museum's 26th Annual Spring Environmental Lecture and Luncheon on Wednesday, April 20, as award-winning journalist Lynn Sherr leads a conversation on the topic "Thriving in a Dynamic Environment" with Dr. Margaret A. (Peggy) Hamburg, former commissioner of the U.S. Food and Drug Administration and now the foreign secretary of the National Academy of Medicine.

Dr. Hamburg, who is also a Museum Trustee, is uniquely positioned to address the question of how we can prepare for unexpected and unprecedented health impacts of human-driven changes in local and global ecosystems—and how public health policies and individual actions help keep us healthy and thriving in the 21st century. Dr. Hamburg is a recognized expert in infectious disease, bioterrorism and emergency preparedness, global health, and public health policy. As the foreign secretary of the National Academy of Medicine, she serves as the body's senior advisor on international issues and as liaison to academies of medicine and science around the world.

A graduate of Harvard Medical School, Dr. Hamburg has an extensive record of public service. She served as commissioner of the U.S. Food and Drug Administration from 2009 until 2015, making her one of the longest-serving officials to hold the post. Under President Bill Clinton, she was assistant secretary for planning and evaluation at the Department of Health and Human Services, where she created a bioterrorism response program. From 1991 to 1997, she was health commissioner of New York City, where her work included developing programs for controlling the spread of tuberculosis and HIV/AIDS. She has also served as assistant director of the National Institute of Allergy and Infectious Diseases at the National Institutes of Health and in the U.S. Office of Disease Prevention and Health Promotion.

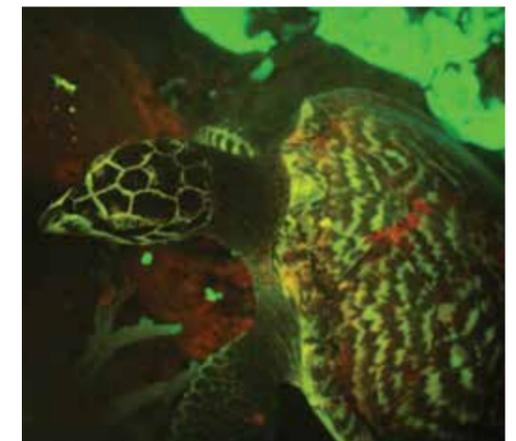
For more information about the Environmental Lecture and Luncheon and to purchase tickets, visit amnh.org/ell. A recording of the event will be available on iTunes and on amnh.org/podcasts in May.

Museum Researchers Discover Biofluorescence in Sea Turtles

Biofluorescence, which lets animals absorb light and emit it as different colors, has been observed in many marine creatures, including corals and fishes. But late last year, marine biologist David Gruber, a professor at Baruch College and a research associate at the Museum, captured the first-ever footage of a sea turtle emitting vivid green hues of biofluorescent light.

The light produced by biofluorescence is normally not visible to the human eye, but blue excitation lights and green emission filters can reveal it. On a night dive in the Solomon Islands, Gruber encountered an endangered hawksbill sea turtle (*Eretmochelys imbricata*) that swam near the blue LED light he was using to excite biofluorescence in nearby corals. To his surprise, the turtle also lit up, exhibiting bright shades of neon green and red.

Further study showed that the hawksbill was not alone among turtles with the specialization—a loggerhead turtle (*Caretta caretta*) in an aquarium also glowed bright green when exposed to blue LED light. A study detailing the phenomena was published in the journal *American Museum Novitates* by Gruber and co-author John Sparks, curator in the Museum's Department of Ichthyology, earlier this year.



A hawksbill sea turtle photographed glowing under LED light.

Photo © D. Gruber, C. Somodevilla/Getty Images

ALL IN THE FAMILY

Crocodiles belong to a larger group known as archosaurs, which includes their extinct relatives, pterosaurs and the non-avian dinosaurs, as well as modern birds. You can learn more about this wide-ranging family in the exhibition *Dinosaurs Among Us*.

BIG FOR A LITTLE GUY

It may seem strange to call an animal that can grow as long as 6.5 feet a “dwarf,” but dwarf crocodiles are puny compared to their cousins. The largest recorded example of a saltwater crocodile, for instance, was a specimen captured in the Philippines in 2012 that measured more than 20 feet long and weighed more than a ton.

DOTING PARENTS

Crocodiles provide a lot of care for their young. Dwarf crocodiles, alligators, and other species stick close to their offspring after they’ve hatched, protecting them from birds and other predators while the babies learn to swim and hunt, a common characteristic of archosaurs.

TO CATCH A MEAL

While dwarf crocs do their hunting on land, others stick to the water. Species like the narrow-snouted Indian gharial chase down fish, while larger examples like the Nile crocodile are ambush predators, which can lie in wait for unwary prey for days on end.

CROCODILE COMMUNICATION

Many types of crocodiles are social animals and communicate using a wide variety of vocalizations, including bellows, roars, grunts, hisses, and high-pitched “pips.” Some of these occur in the infrasound range—an extremely low-frequency band of the sound spectrum that humans are unable to hear.

Primordial Predator

Crocodiles and their relatives are some of the most enduring creatures on the planet. Ancient crocodylians dominated the landscape before the time of their cousins, the dinosaurs, and their successors have survived and thrived into the modern day. The new exhibition *Crocs: Ancient Predators in a Modern World* brings a variety of live crocodiles and their relatives, including alligators and dwarf crocodiles, to the Museum, where visitors can meet these primordial predators in the flesh.

Some early crocodylians, like *Hesperosuchus agilis*, lived on land and boasted lithe, agile builds more evocative of a modern greyhound than today’s crocodiles. Other species, like *Deinosuchus riograndensis*, which was discovered by Museum paleontologist Edwin Colbert in 1954 and lived around 75 million years ago, looked more like its modern relatives, but likely reached lengths of up to 55 feet, much larger than modern crocs.

While these giant crocs are long extinct, many species of crocodiles, as well as their relatives, alligators and gharials, still thrive. Species like the saltwater crocodile and American alligator loom large in the popular imagination and waterways alike, but they’re not the only examples. Smaller species like the caimans of South America and the dwarf crocodiles of Western Africa (*Osteolaemus tetraspis*) grow to no more than 6.5 feet (2 meters) long.

Unlike their larger relatives, which tend to live in open, fast-flowing rivers, dwarf crocodiles dwell in small freshwater streams and muddy swampland. Some have even been found living in isolated watering holes on the savanna, retreating to burrows when the rainy season ends and their habitat dries up.

Dwarf crocodiles don’t spend as much time basking in sunshine as larger crocs and are much more likely to be seen on land at night—habits that can likely be attributed to their relatively diminutive size. While they boast the same bony plating and scale armor that makes other crocodiles so formidable, their smaller proportions mean that they are not only predators, but also occasionally prey, even when they reach adulthood.

See live crocodiles like this one in *Crocs: Ancient Predators in a Modern World*, which opens on May 28. Members receive special benefits.



Osteolaemus tetraspis



Catalog no. 16/1900

Supernatural Serpent

This colorful headdress from the Museum’s collection represents a supernatural serpent, most likely a lightning snake. For the Nuu-chah-nulth people of the Pacific Northwest Coast, a headdress like this one would be part of the regalia worn by ceremonial dancers who have inherited the privilege of taking the role of this creature.

Lightning snakes resonate with whaling, an activity that was a vital part of the traditional culture of the Nuu-chah-nulth people, in what is now the west coast of Vancouver Island in Canada. Lightning snakes assist Thunderbird, a different supernatural creature who hunts whales, by stunning the whales before Thunderbird attacks.

“Thunderbird shoots the lightning snakes down from the sky world, echoing Nuu-chah-nulth endeavors from their whaling canoes,” says Peter Whiteley, curator in the Division of Anthropology.

The Museum’s collection also includes a significant Nuu-chah-nulth hat acquired in 1899, woven from cedar bark, spruce root, and marine grass, that depicts scenes of successful whale hunting by canoe.

The headdress was purchased for the Museum by Phillip Jacobsen, a Norwegian trader, in 1897, the first year of the Museum’s Jesup North Pacific Expedition, along with several others. Only the headdress shown above is on view in the Hall of Northwest Coast Indians, but images of the others can be seen in the Anthropology’s Division online database at amnh.org.

Download the Museum’s free Explorer app to see a 360-view of this artifact.

SPECIAL RELATIONSHIP

Among Northwest Coast peoples, the right to perform with a lightning snake headdress is limited to the Nuu-chah-nulth and their relatives on the U.S. side, the Makah—except where the right has been transferred through marriage from a Nuu-chah-nulth family to a family in another Northwest Coast nation.

MODERN ART

Images of lightning snakes appear in work by artists today. Nuu-chah-nulth artist Joe David recently collaborated with Tlingit artist Preston Singletary to create a striking lightning snake sculpture from sandblasted glass and cedar bark.

MEANWHILE IN ANCIENT MESOAMERICA

Powerful feathered serpents appear in other cultures. The Aztecs worshipped a dragon-like deity named Quetzalcoatl, often represented with the sharp fangs and winding body of a snake, and the deep green feathers of the quetzal, a tropical bird. Paleontologists borrowed the name for an extinct flying reptile, the pterosaur *Quetzalcoatlus northropi*, discovered in Texas in the early 1970s.

COMING SOON: DIGITAL TOTEM

The Hall of Northwest Coast Indians, the Museum’s oldest gallery, will be home to a new interactive installation this year: the Digital Totem. Visitors will be able to browse maps of Northwest Coast communities, hear from First Nations community members, create soundscapes from Northwest Coast nature sounds and music, and examine items in the collection through 360-degree rotations.

Previous page © J. McDonald; this page © AMNH/D. Finnin

THE

THE MUSEUM'S NEWEST ICON WAS
DISCOVERED IN **PATAGONIA** AND
ASSEMBLED IN **ONTARIO** BEFORE
GOING ON DISPLAY IN **NEW YORK.**

TITANOSAUR

ARRIVES



Titanosaur fossils were digitally scanned at the dig site.

PATAGONIA

In 2014, a rancher in the arid Patagonia region of Argentina stumbled upon a bone like none he'd ever seen before. He shared his discovery with the Museo Paleontológico Egidio Feruglio, which brought in paleontologist Dr. Diego Pol and colleagues to assess the extraordinary find.

When they arrived at the site and began uncovering fossils, it became clear to Dr. Pol and team that they were looking at an unusually large animal. Dr. Pol, who received his Ph.D. degree in a joint program between Columbia University and the American Museum of Natural History in 2005, emailed a photo of an 8-foot femur, or thigh bone, to his mentor, Macaulay Curator of Paleontology Mark Norell. By then, the paleontologists had inferred that this fantastic fossil was from an animal that belonged to a group known as the titanosaurs, a sub-group of the plant-eating dinosaurs known as sauropods.

Now an arid desert, Patagonia was a lush, forested region millions of years ago, and home to numerous sauropod species. In recent years, sites there have begun surrendering these fossils at a shocking rate.

"We are finding these creatures in South America and Central Asia, places that are much less explored," Pol said at the unveiling of The Titanosaur cast earlier this year. "About half of the known titanosaur species come from South America, and the South American titanosaurs were the ones who achieved the largest body sizes."

"If I was going to pick any place to go looking for [sauropods], I think where Diego and his team are looking would be a really good place," added Norell.

Plans soon began to make a cast of this stunning discovery part of the Museum's world-famous fossil halls. First, though, Pol and his team had to get the fossils out of the ground.

Over the next 18 months, the team made seven separate expeditions to the site. Heavy equipment was brought in, and recovered bones were moved out via flatbed trucks on a road that was built just for that purpose.

The result was a bonanza of 225 titanosaur fossils. Though the remains are thought to represent as many as six individuals, more than 70 percent of the skeleton has been recovered, resulting in a remarkably complete fossil titanosaur.

Still, the actual construction of The Titanosaur would happen thousands of miles north, in Ontario, Canada.



ONTARIO

An unassuming Canadian warehouse isn't, perhaps, the first place you'd expect to find a dinosaur factory. But that's just what this nondescript headquarters of Research Casting International (RCI) is. Inside, sparks fly and heavy machinery whirrs as a crew of 25 employees assembles casts of dinosaurs and other fossil animals that delight and educate visitors at museums around the world.

RCI is in business because ancient bones, even huge ones, are fragile things, and original fossils are often kept in storage after being excavated. The Museum's fourth floor halls do present real fossils—85 percent of the specimens on display are the originals, in fact. But some of the larger mounts visitors see, like the *Barosaurus* in the Theodore Roosevelt Rotunda, are casts because the real fossils would be much too heavy to mount.

Even for a company that specializes in building life-size replicas of some of nature's most notable behemoths—RCI also created the Museum's *Barosaurus* in 1991—The Titanosaur was a big job.

Before the fossils were removed from the site, RCI digitally scanned each piece, producing a set of 3D blueprints for creating a replica of a titanosaur skeleton—though of course, paleontologists would need to infer some of the "missing pieces" by looking at closely related species.

Back in RCI's Ontario workshop, industrial cutters shaped Styrofoam into models of the bones, which were then used to make rubber molds that were filled with fiberglass resin. Once the resin hardened, it was removed from the molds, handcrafted to the precise measurements of the fossil excavated in Argentina, and mounted on steel support beams in a pose specified by Pol and Norell.

Though life-sized, the resulting cast is exponentially lighter than the fossils or the live animal, which researchers believe weighed around 70 tons, or as much as 10 African elephants.



Curator Mark Norell (left) and RCI president Peter May (right) observe the construction of the cast.

Field photos courtesy Research Casting International; other photos © AMNH/D. Finnin, and M. Shanley

NEW YORK

Like so many globe-trotting trips, The Titanosaur's journey came to a close in New York City. The completed cast arrived at the Museum in 45 separate pieces, some of them so large they were barely squeezed into the building. Then, the fiberglass casts on steel beams were joined together in a massive cast—a feat of construction that was completed inside of a week.

The new addition to the Museum's fossil floors is so huge, it barely fits in its new home: at 19-feet-high, the cast grazes the ceiling of the Wallach Orientation Center, and at 122 feet long, it doesn't quite fit inside the space, poking its head out in a friendly welcome toward the staircase. What's perhaps most astonishing is that the animal hadn't yet reached its full size when it died—it was a juvenile, as scientists learned from analyzing the fossils. Some of those original fossils are now on display nearby, on loan from the Museo Paleontológico Egidio Feruglio.

Over the last few decades, paleontology has made great leaps thanks to new technology and methods. Researchers are now able to analyze specimens in ways they never imagined, using CT scanners to reveal anatomical details that were previously invisible, or create digital 3D scans that can be manipulated and studied like never before. Such new tools make a discovery of this scale even more exciting.

"There's nothing like finding a great new fossil, especially a big one like this one," said the Museum's Provost of Science Mike Novacek. "The Titanosaur itself is ancient, but it nevertheless embodies and reflects the very modern, dynamic, and thrilling state of paleontology today."

The Titanosaur exhibit is open now and is free for Members.

Generous support for The Titanosaur exhibit has been provided by the Susan S. and Kenneth L. Wallach Foundation.



</ HACKING > The D1N0S

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ast fall, dozens of teams of programmers, developers, and other computer science specialists hunkered down in the Museum's halls for a weekend. Over the span of 24 hours, these coders were challenged to create new research tools for paleontology at the Museum's second annual hackathon: Hack the Dinosaurs.

Begun in 2014 by the Museum's BridgeUP: STEM education program—which is focused on the intersection of science and computer science—hackathons at the Museum aim to bring people from the local tech community into the fold. Professional coders may love learning about dinosaurs or stars as much as anyone, but they don't necessarily understand how their skills may be useful in driving forward the science on display in the fossils halls.

"Computer science and programming are important tools that modern scientists use in their work, and this lets us provide a place where our researchers can be involved in the development of tomorrow's tools," says Christina Wallace, who leads BridgeUP: STEM.

The chance to brainstorm with paleontologists is also a big draw for programmers like Benjamin Bojko, who pointed out that "the opportunity to be at the Museum and work with scientists doesn't happen too often."

The Museum's call for hackers also helps bring in a more diverse brain trust, which is in keeping with BridgeUP's goal of attracting more women and minorities to tech careers and

1 supporting them once they arrive. The Museum's hackathons
2 have about a 50/50 gender split in attendance, Wallace points
3 out—much greater parity than comparable events.

4 With one hackathon under their belts, the BridgeUP team
5 had learned the importance of identifying specific questions.
6 At Hack the Dinosaurs, hackers were still free to create whatever
7 they wanted—but they were also provided with a list of
8 problems that Museum paleontologists, led by Macaulay
9 Curator of Paleontology Mark Norell, had encountered
10 and hoped to solve with a little technological help.

11 "We wanted the challenges to serve the twin missions
12 of the Museum of promoting science education as well
13 as scientific research," said Aki Watanabe, a Ph.D.-degree
14 candidate studying with Norell at the Richard Gilder
15 Graduate School. To that end, challenges looked to both
16 improve research methods and make that research more
17 accessible to the public.

18 One solution that researchers had requested was a tool
19 to help scientists quickly and easily build phylogenetic
20 trees. Also known as trees of life, these branching diagrams
21 help visualize the relationships among different forms
22 of life. Drawing these diagrams, or replicating them from
23 other papers, can be tedious, time-consuming work for
24 paleontologists who are preparing new studies for publication.

25 A team at the hackathon produced a program that allows
26 researchers to scan an existing tree of life from a PDF and
27 convert the result into an accessible file format that users can

edit as they please. And because these trees are used broadly in biology, this new tool for building them could be used in numerous other fields as well.

Another program designed at Hack the Dinosaurs will help paleontologists search for 3D scans of ancient fossils more efficiently. These scans are made by imaging tiny slices of a fossil in high resolution, resulting in huge files. If researchers need to study one of these scans, it can mean downloading terabytes of data at a time. Downloading the wrong scan can be a time-consuming mistake. And if you don't know exactly what you're looking for, browsing through collections like the Museum's becomes a tedious and time-consuming endeavor.

"Online repositories for CT data of specimens with a sleek, modern interface and automatic 3D reconstructions of skull

24 and braincase from CT data of specimens would really help
25 my work," says Watanabe. That's just the kind of project that
26 programs started at the hackathon could become.

27 With only 24 hours of work time, hackathons don't produce
28 many finished products. Rather, events like the Museum's
29 help plant the seed of an idea, then count on a thriving
30 community of developers to help cultivate its potential.
31 All the programmers who participate agree to make anything
32 that comes out of the hackathon open source, meaning the
33 software is available for anyone to use, free of charge. The
34 tools are also free to build on, so programs designed here for
35 paleontologists will be available to scientists in other disciplines,
36 who can develop and customize them for their own purposes.

36 "Being able to use my professional skills [here] was
37 extremely exciting," says Carol Lin, who brought her
38 expertise in data analytics to the hackathon and helped
39 design the tree of life identification program Sapling Detector.

40 Today, the collaboration continues: out of 25 products
41 developed at Hack the Dinosaurs, Museum staff is working with
42 hackers to further develop six. The others are available online.

43 "All of these projects are hosted on [programming forum]
44 Github," says Wallace. "Anyone can go and take a look at what
45 people have done and, if they have the capacity, they can
46 work on it themselves."

44 Learn more about BridgeUP:STEM and upcoming events
45 at amnh.org/learn-teach.

46 *BridgeUp:STEM is generously supported by a grant from*
47 *the Helen Gurley Brown Trust.*

< The challenges serve
the twin missions of the
Museum—promoting
science education as well as
scientific research.

</>



Developers show off products developed at Hackathon while visitors take the chance to learn more about the Museum's collections (inset).



Photos © AMNH/C. Chesek

HOME SWEET HOME

YOUR MICROBES MOVE IN WHEN YOU DO

Each human is an ecosystem of millions and millions of microbes. As it turns out, they make themselves right at home in our houses, too, everywhere from bathroom tiles to TV screens.

“To microbes, the diversity of places to live in a home must be enormous,” Curators Rob DeSalle and Susan Perkins note in their new book, *Welcome to the Microbiome*.

Many factors can influence the microbiome of a home, including temperature, humidity, and the individuals who spend time there. “If you let people use a room after it has been sterilized, within an hour you’ll find 500,000 cells per square inch of surface,” says Jack Gilbert, a researcher at Argonne National Laboratory and principal investigator for the Home Microbiome Project.

THE SECRET WORLD INSIDE YOU
OPEN NOW AND FREE FOR MEMBERS

The spots marked with this icon tend to be among the most species-rich spaces in a house.

BEDROOM
Kitchens and bathrooms get cleaned frequently, and living rooms host all manner of guests. Since bedrooms typically host just one or two people, they are excellent indicators of the microbiomes of those individuals.

GARDEN
The world just outside your door is teeming with life you can’t see, even more so than your home. Researchers estimate there are up to 38,000 different types of microbes in just a single gram of soil.

LIVING AND DINING ROOMS
Because we’re constantly shedding microbes, entertaining visitors can transform the microbiome of your home. “Sitting in a living room, people will leave behind a distinct, microbial signature in just half an hour,” says Gilbert.

KITCHEN
The microbial populations of your home are shaped by cleaning. Objects that get cleaned frequently—like your cutting board or countertop—are less diverse than places you’re not washing as often. Some of the most biologically diverse surfaces in kitchens? Exhaust fans over the oven.

DOGS
The microbes on Rover’s skin and fur are just as diverse as those that live on you, and maybe even more, so it’s not surprising that homes with pet dogs have microbiomes that are more diverse than those without them.

DOORWAY
The frames around the inside and outside of your front door rest just inches from one another. It’s a very important couple of inches, though. A 2013 study in the journal *PLOS ONE* found that outdoor door trims, exposed to the elements, hosted microbial communities that were more similar to those found in soil and leaves.

BATHROOM
Microbial populations can have unexpected things in common. The microbiome of your toilet seat, for instance, is most similar to another household object that touches your skin a lot—your pillowcase. Sleep tight!



TO LEARN MORE ABOUT MICROBIOLOGY, VISIT OLOGY, THE MUSEUM’S SCIENCE SITE FOR KIDS, AT bit.ly/MicroBiology

Programs and Events

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

For updates and reminders, sign up for monthly Calendar Highlights for Members by sending your membership number and request to subscribe to members@amnh.org. The Museum does not trade, rent, or sell this information.

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.

Availability may be limited. Please purchase tickets in advance.

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

Information about programs is current as of March 1. Please check amnh.org/calendar for updates.

APRIL



SciCafe: How “Paleo” is Your Diet?
Wednesday, April 6
7 pm

Free for 21+ with ID
Join molecular anthropologist **Christina Warinner** as she explains how scientists are reconstructing the microbial populations of ancient humans to better understand the lives and health of our ancestors, and whether the popular “paleo” diet has any relation to real human history.

Milstein Science Series Wild Antarctica
Sunday, April 10
11 am–4 pm
Milstein Hall of Ocean Life
Free

Antarctica is the coldest and windiest place on Earth, and there’s much to learn about new discoveries of amazing creatures and the unique geology beneath the ice. Meet live penguins, try hands-on activities, and experience dynamic performances in this family-friendly science festival.

Milstein Science Series Beneath the Ice: Immersive Dome Installation
Monday, April 11–Friday, May 27
Milstein Hall of Ocean Life
Free

Take a deep dive into Antarctic waters to explore a hidden world beneath the ice. Once thought to be low in species diversity, the Antarctic is now known to be home to a rich variety of life. This immersive dome experience showcases a surprising and visually stunning array of marine life that flourishes on, around, and underneath the Antarctic ice.

Milstein Hall of Ocean Life hours subject to change.

Family Bird Walks
Saturday, April 16
9 am, 11:30 am, 2 pm
77th Street Entrance to the Museum
\$15

Observe the birds of Central Park with Museum naturalist **Noah Burg**. Young explorers will begin their adventure by learning the tools and skills of observation using Museum specimens. Then we will head out to Central Park to identify the many bird species and habitats in our own backyard. Binoculars and bird guides are included. This program is recommended for families with children ages 4–10.

Naming and Measuring Nature
Saturday, April 16
2–3:30 pm
Free; registration required; call 212-769-5200

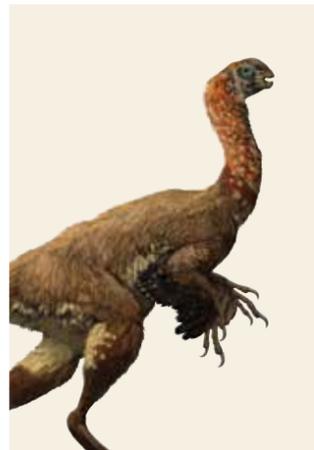
Join a guide for a tour that details how scientists develop systems to measure and categorize nature. We’ll learn how scientists measure the speed of light, the hardness of minerals, and many more factors, as well as explore taxonomic systems used for naming animals.

Exhibitions

Admission is by timed entry only.

Dinosaurs Among Us

From flight to feathers, nests to wishbones, and brains to lungs, this exhibition highlights the continuities between living dinosaurs—birds—and their extinct ancestors.



The Secret World Inside You: The Human Microbiome

New research shows that, rather than make us sick, many of the bacteria living in and on our bodies are often key to our health. Come explore the new world that’s being discovered in human bodies.



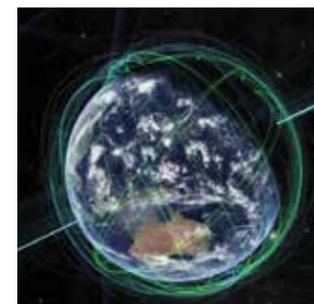
Gravitational Waves: Messengers From the Warped Universe
Monday, April 18
7:30 pm
\$12

Some of the most violent events in the universe warp space-time and create gravitational waves. Discover how we search for these ripples in space-time and decode the information they carry about events as far back in time as the first moments after the Big Bang.



Lunchtime Bird Walks in Central Park
Four Tuesdays, April 26–May 17
Noon–1:30 pm
\$50

Join ornithologist **Paul Sweet** on walks through Central Park during spring migration. Learn how to identify the varied bird species that pass through New York City using field marks, behavior, and song.



The Force Fields Around Spaceship Earth
Tuesday, April 26
7 pm
\$12

Discover the invisible force fields all around us that make life on Earth possible. Join **Jana Grcevich** and **Irene Pease** as they explore the various dangers of space that could destroy us, and how Earth’s magnetic and gravitational fields keep us safe.

Countdown to Zero
Free for Members

This exhibition, developed in collaboration with The Carter Center, highlights scientific innovations that are ridding the world of ancient afflictions—including the 30-year campaign that may soon eradicate Guinea worm disease.



Opulent Oceans
Free for Members

This exhibition features illustrations of sea creatures by generations of explorers, from rare and beautiful scientific works in the Museum Library’s singular collections.



MAY

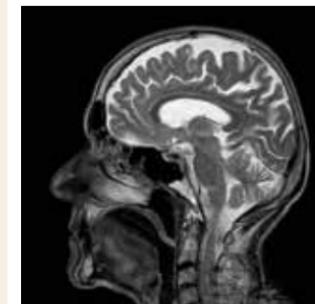
SciCafe: Addiction and the Brain
Wednesday, May 4
7 pm

Free for 21+ with ID
What makes one more vulnerable to addiction than another? Psychiatrist **Edmund Griffin** explains how epidemiology, cocaine-addicted rats, and molecular neuroscience all help to shed light on one of our society’s most troubling questions: Why is it that some people just can’t get enough?

Birding for Beginners: Prospect Park
Saturday, April 30
10 am–1 pm
\$25

Discover the joy of bird watching with Museum ornithologist **Paul Sweet**. Learn the basics of bird identification, how to use birding equipment properly, and how to read a field guide. April is a particularly good time to observe many birds returning from their winter homes in the tropics.

Binoculars will be provided but participants are welcome to bring their own.

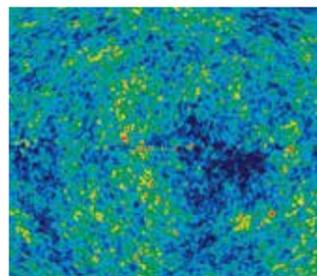


From the Big Bang to the Multiverse and Beyond

Thursday, May 5
8:30 pm

\$10

We know the universe began 13.7 billion years ago in an event called the Big Bang, but many questions remain. Is our universe part of a larger multiverse? What is causing the accelerating expansion of the cosmos? In a dazzling, full-dome presentation simulcast from the Adler Planetarium in Chicago, astrophysicist **Michael Turner** and local host **Carter Emmart**, director of astrovisualization at the Museum, will illustrate what we know and how we know it, as well as the big ideas and puzzles of cosmology today.



Identification Day

Saturday, May 7
Noon–4 pm

Free

Inspired by the legacy of Theodore Roosevelt, the Museum celebrates natural history collections by inviting visitors to bring in their own specimens to the annual Identification Day. Scientists will attempt to identify your discoveries while showing you some specimens from the Museum's rarely seen collections.

Our Place In The Universe

Monday, May 9
7:30 pm

\$12

What is our place in the universe? Since the time of Galileo, our understanding of this fundamental question has been overthrown again and again as telescopes have evolved. Join astronomer **Jason Kalirai** on a journey through space to uncover the latest evidence about where we sit in the universe and explore the possibility of life on other worlds.

Member Highlight Tour: Funny Things

Sunday, May 15
2–3:30 pm

Free; registration required; call 212-769-5200

A nose that's not for smelling? Teeth that don't bite? A fly that can walk upside down on the ceiling? Join a Museum guide on a tour to discover these and other funny facts about exhibits at the Museum.

Path of the Planets

Wednesday, May 18
6–7 pm

\$8 children; \$12 adults

As the planets appear to travel across the cosmos they create a path through the constellations of the zodiac. Join us to follow this ancient path through the stars in the Hayden Planetarium and discover how it can help astronomers observe and identify different cosmic objects.



Trip to Sagamore Hill with Julie Feinstein

Saturday, May 21
8:45 am–4 pm

\$95

Get inspired by the legacy of one of America's most popular presidents. Sagamore Hill was the home of Theodore Roosevelt from 1885 until his death in 1919. Enjoy a guided tour of the Roosevelt home and museum and explore the natural surroundings with Museum naturalist **Julie Feinstein**.

Transportation is included. Please bring a bagged lunch.

Highlights Tour: Earth as a Peppercorn

Sunday, May 22
10:30 am–noon

Free; registration required; call 212-769-5200

Can you picture the size of our solar system? Join a guide for a journey around the Museum on a scale walk of our corner of the cosmos, where Earth is the size of a peppercorn, the Sun is as big as a soccer ball, and each step covers more than 5 million miles. Hear about each of the planets and other parts of the solar system and learn about our place in the universe.



Opposition of Mars

Tuesday, May 31
7 pm

\$12

In the coming months, Mars will be easily visible in the night sky. Join **Steven Beyer** and **Joe Rao** as they illustrate Mars' place among the stars of the constellation Scorpius and explain what happens during the Opposition of Mars, when the Red Planet and the Sun are on opposite sides of Earth. The hosts will also share updates and discoveries from recent Mars missions.

JUNE

SciCafe: Explore21 Cuba

Wednesday, June 1
7 pm

Free for 21+ with ID

Cuba is an archipelago of islands in the Caribbean and home to an astonishingly diverse and unique set of animals and plants. Join Museum scientists for a lively discussion about their recent expedition to Cuba and the new avenues for scientific collaboration.

Birding in Jamaica Bay with Paul Sweet

Saturday, June 4
10 am–1 pm

\$25

Visit the Jamaica Bay Wildlife Refuge, which encompasses over 9,000 acres of woods and wetlands all within New York City. A prime birding spot, over 325 species have been recorded at the Wildlife Refuge, including the glossy ibis, osprey, tern, laughing gull, oystercatcher, and many more that breed in the area during the summer months.

Quarks to Quasars!

Saturday, June 11
10:30 am–noon

Free; registration required; call 212-769-5200

How far away is a quasar? How small is a quark? Explore these fascinating phenomena and many more as you are guided on a special tour along the Heilbrunn Cosmic Pathway.

Nature Walk with Julie Feinstein

Sunday, June 12
11 am–1 pm

\$12

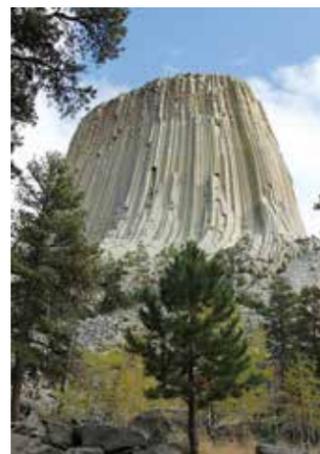
New York City is teeming with wildlife—but you need to learn where to look for it! Join naturalist **Julie Feinstein** on a wildlife exploration of Central Park and learn about nature in the Museum's backyard. Bring a lunch to enjoy after the walk, where you'll picnic in front of the Belvedere Castle with Julie.



Please check amnh.org for Member ticket prices for live animal exhibits and giant-screen 2D and 3D films.

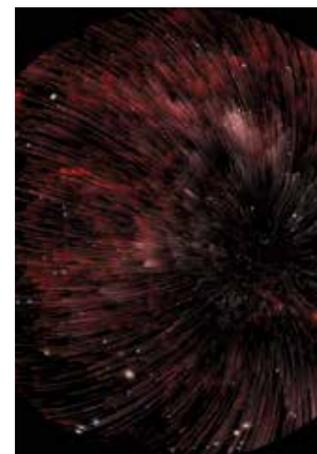
Crocs: Ancient Predators in a Modern World

Explore the complex lives of crocodilians in this exhibition, which features live species from around the world, including a rare dwarf crocodile.



National Parks Adventure

Narrated by Academy Award-winning actor Robert Redford, *National Parks Adventure* lets audiences soar over red rock canyons, hurtle down steep mountain peaks, and explore our country's most legendary spaces in an action-packed celebration of the 100-year anniversary of the National Park Service.



Hayden Planetarium Space Show: Dark Universe

Narrated by Neil deGrasse Tyson, the Space Show celebrates pivotal discoveries and the cosmic mysteries that remain. Gaze up at the Milky Way from Mt. Wilson Observatory in California, plunge into Jupiter's atmosphere with a NASA probe, and more.

Credits

The American Museum of Natural History gratefully acknowledges the Richard and Karen LeFrak Exhibition and Education Fund.

Dinosaurs Among Us is proudly supported by Chase Private Client.

Additional support is generously provided by Dana and Virginia Randt.

Generous support for The Secret World Inside You and its educational resources has been provided by the Paul and Irma Milstein Foundation and the Milstein Family.

The Secret World Inside You is proudly supported by the Janssen Pharmaceutical Companies of Johnson & Johnson.

Credits continue on page 18.



Coloring the Universe

Monday, June 13

7:30 pm

\$12

The data collected by giant telescopes is meant for scientific research, but it can also be presented as images of incredible beauty. **Travis Rector** will explain how researchers create images that are both aesthetically pleasing and scientifically useful while **Carter Emmart**, director of astrovisualization at the Museum, projects examples of this stunning imagery on the planetarium dome.

Member Highlights Tour

Saturday, June 18

2-3:30 pm

Free; registration required;

call 212-769-5200

Families are invited to take part in this tour for adults and children alike. Expert guides will lead you through the Museum's halls to explore some family favorites.



Fun with Fossils

Saturday, June 25

9 am-4 pm

\$95

Pack your collecting bag, old sneakers, and lunch, and travel back in time with **Carl Mehling**, senior scientific assistant in the Division of Paleontology, for an expedition to Big Brook in Monmouth County, New Jersey. The fossil-rich site offers a variety of invertebrate and vertebrate fossils from the Late Cretaceous period, making it ideal for collecting. Feel free to bring your own collecting equipment.



Credits

The SciCafe series is proudly sponsored by Judy and Josh Weston.

The SciCafe event "How 'Paleo' is Your Diet?" is presented in collaboration with The Leakey Foundation.

SciCafe is generously supported by the Science Education Partnership Award (SEPA) program of the National Institutes of Health (NIH).

Support for Hayden Planetarium Programs is provided by the Schaffner Family and the Horace W. Goldsmith Fund.

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

The Museum's Explore21 Initiative is supported by the leadership contributions of Katheryn P. and Thomas L. Kempner, Jr., and Linda R. and William E. Macaulay.

Unsolved Mysteries of the Universe

Tuesday, June 28

7:00 pm

\$12

Are we alone in the cosmos? What happened in the early universe? What are dark matter and dark energy? Join **Jackie Faherty** and **Jana Grcevic** as they explore some of the most important unsolved mysteries of astronomy and cosmology, and how scientists seek to solve them.

Credits continued from page 17.

The Secret World Inside You is supported by the Science Education Partnership Award (SEPA) program of the National Institutes of Health (NIH).

The presentation of Opulent Oceans: Extraordinary Rare Book Selections from the American Museum of Natural History is made possible through the generosity of the Arthur Ross Foundation.

Countdown to Zero is presented by the American Museum of Natural History in collaboration with The Carter Center.

Countdown to Zero is proudly supported by the Conrad N. Hilton Foundation, Lions Clubs International Foundation, Mectizan Donation Program, and Vestergaard.

This exhibition is made possible by the generosity of the Arthur Ross Foundation.

Dark Universe was created by the American Museum of Natural History, the Frederick Phineas and Sandra Priest Rose Center for Earth and Space, and the Hayden Planetarium.

Made possible through the generous sponsorship of Accenture.

And proudly supported by Con Edison.

The Museum also gratefully acknowledges major funding from the Charles Hayden Foundation.

Presented with special thanks to NASA and the National Science Foundation.

Dark Universe was developed by the American Museum of Natural History, New York (www.amnh.org) in collaboration with the California Academy of Sciences, San Francisco, and GOTO INC, Tokyo, Japan.

APRIL

6

WEDNESDAY

SciCafe: How "Paleo" is Your Diet?

After-Hours Program

10

SUNDAY

Wild Antarctica

Family Program

11

MONDAY

Beneath the Ice

Immersive Dome Installation

Daily through Friday, May 27

16

SATURDAY

Family Bird Walks

Family Program

Naming and Measuring Nature

Member Program

18

MONDAY

Gravitational Waves: Messengers From the Warped Universe

Hayden Planetarium Program

Hayden Planetarium Program

26

TUESDAY

The Force Fields Around Spaceship Earth

Hayden Planetarium Program

Spring Lunchtime Bird Walks in Central Park

Nature Walk

Four Tuesdays, April 26 through May 17

30

SATURDAY

Birding for Beginners: Prospect Park

Member Excursion

Photo © AMNH/ C. Cheseck, D. Firmin, R. Mickens, M. Shanley, or courtesy of Wikimedia Commons with the exception of The Secret World Inside You (© AMNH/K. Platts), Countdown to Zero (© The Carter Center/E. Staub), Dinosaurs Among Us (© Z. Chuang/Peking Natural Science Organization), Crocs (© J. McDonald), National Parks Adventure (© VisitTheUSA), Gravitational Waves and Mars (NASA), Big Bang (NASA/WMAP), and Sagamore Hill (National Parks Service)

MAY

4

WEDNESDAY

SciCafe: Addiction and the Brain

After-Hours Program

5

THURSDAY

From the Big Bang to the Multiverse and Beyond

Hayden Planetarium Program

7

SATURDAY

Identification Day

Family Program

9

MONDAY

Our Place In The Universe

Hayden Planetarium Program

15

SUNDAY

Member Highlight Tour: Funny Things

Member Program

18

WEDNESDAY

Path of the Planets

Member Program

21

SATURDAY

Trip to Sagamore Hill with Julie Feinstein

Member Excursion

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SUNDAY

Highlights Tour: Earth as a Peppercorn

Member Program

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TUESDAY

Opposition of Mars

Hayden Planetarium Program

JUNE

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WEDNESDAY

SciCafe: Explore21 Cuba

After-Hours Program

4

SATURDAY

Birding in Jamaica with Paul Sweet

Member Excursion

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SATURDAY

Quarks to Quasars

Member Program

12

SUNDAY

Nature Walk with Julie Feinstein

Member Program

13

MONDAY

Coloring the Universe

Hayden Planetarium Program

18

SATURDAY

Member Highlights Tour

Member Program

25

SATURDAY

Fun with Fossils

Member Excursion

28

TUESDAY

Unsolved Mysteries of the Universe

Hayden Planetarium Program

The Gilder Center

Supporting Science Learning in the 21st Century



A conceptual design of the Central Exhibition Hall of the Gilder Center, above, which will feature a working section of the Museum's collections, house an immersive theater and exhibition niches, and connect to educational laboratories and classrooms.

Millions of visitors, including hundreds of thousands of school children, come to the Museum each year to view its world-class collections, from the towering sulfide chimneys in the Gottesman Hall of Planet Earth to the ancient dinosaurs and mammals who rule the fourth floor. But only a small fraction have a chance to take a class, go behind the scenes with a Museum scientist, or see the latest research tools in action. The planned Richard Gilder Center for Science, Education, and Innovation aims to change that, by bringing all of the excitement of an active scientific and educational institution to every visitor.

"A distinctive strength of the Museum's educational programs is that they offer a connection to actual scientific work, to science practitioners, and to the tools and methods of scientific thinking and research," President Ellen Futter said when the Museum's Board of Trustees endorsed a conceptual design for the new building, planned for the Columbus Avenue side of the Museum complex. "The Gilder Center will extend this experience to all."

The Central Exhibition Hall, which will serve as the Museum's Columbus Avenue entrance, will reveal a working section of the Museum's collections, house an immersive theater that will feature the latest scientific research made accessible with advanced imaging technologies, and connect to the Museum Library, which will be made more accessible to visitors with the addition of a space for reading and contemplation surrounded by views of Theodore Roosevelt Park. A two-story insect hall, which will become the new home of the Museum's live butterfly conservatory, will also house specimens from the Museum's insect collections.

The Gilder Center will include educational laboratories and classrooms that place science learning in the context of world-class scientific research and collections, allowing students to carry out research projects and to access the latest digital and technological tools. There will be innovative spaces for teaching science to a broad range of learners, from early childhood to middle school, from families to adults.

"The Museum... offers a connection to actual scientific work, to science practitioners, and to the tools and methods of scientific thinking."

— PRESIDENT ELLEN FUTTER

When architect Jeanne Gang, who leads Studio Gang Architects, began developing the architectural concept for the 218,000-square-foot project, she also seized the opportunity to complete connections among existing Museum galleries, as well as between existing and new space.

"We uncovered a way to vastly improve visitor circulation and Museum functionality, while tapping into the desire for exploration and discovery that are emblematic of science and also part of being human," said Gang. Appraising the design for *The New York Times*, architecture critic Michael Kimmelman agreed.

"There's function to the form," he wrote. "This is a museum in the business of wonderment and awe."

The Richard Gilder Center for Science, Education, and Innovation is expected to open in 2020, at the conclusion of the Museum's 150th anniversary in 2019.

For more information, visit amnh.org/gildercenter.



Renderings by Studio Gang; headshot of J.G. © K. Miyazaki/Redux; headshot of R.A. courtesy Ralph Appelbaum



Architect: Jeanne Gang

One of the hallmarks of architect Jeanne Gang's innovative work in urban settings is the use of natural, organic shapes—from the watery undulations in the high-rise Aqua Tower in Chicago to the tortoise-shell-inspired pavilion over the boardwalk in that city's Lincoln Park Zoo. New York City projects include a 12-story office building adjacent to the High Line called Solar Carve, which took Sun angles into account in sculpting the building's shape.

"Designing spaces that facilitate interaction between science, education, and exhibition experiences will make possible the learning the new Gilder Center aspires to generate," said Gang.



Exhibit Designer: Ralph Appelbaum

Every Museum Member knows exhibit designer Ralph Appelbaum's work. Appelbaum has lent his considerable skills to a number of major projects, including the Rose Center for Earth and Space with its Gottesman Hall of Planet Earth, Cullman Hall of the Universe, and Heilbrunn Cosmic Pathway, the Hall of Biodiversity on the first floor, and the fourth-floor fossil halls.

His firm, Ralph Appelbaum Associates, specializes in the planning and design of museums and related visitor attractions.

Appelbaum, who founded the firm in 1978, has called the Gilder Center "a vision of the Museum of the 21st century made real."

"This will be the place," said Appelbaum, "where young people especially will discover their passion for science and find their futures."

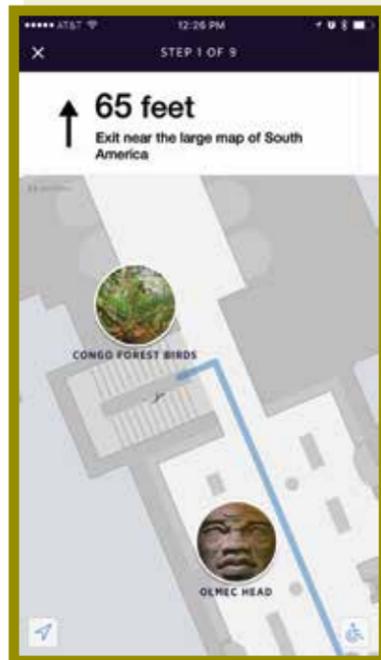
Explorer for Experts

No matter how many times you've been to the Museum, there's always something new to find in these halls—if you know where to look. That's where the updated Explorer app, now available in Beta, comes in.

Whether you're looking to discover a new favorite exhibit or for a few fun facts about dioramas you've long held dear, this highly customizable digital guide is the perfect addition to your next visit to the Museum.

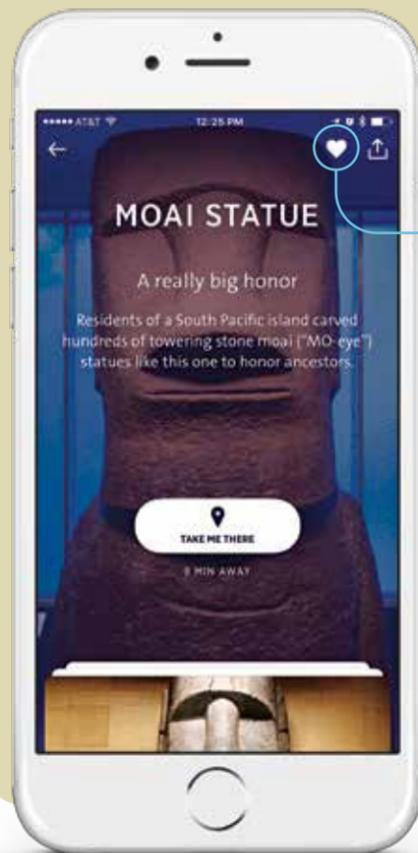
GO THE DISTANCE

Turn on Bluetooth on your device, and Explorer will ping you about what's nearby as you walk through the Museum, give you directions to your next exhibit, and let you know how long it will take to get there—even remind you when your giant-screen film or Space Show is about to start.



CHOOSE YOUR INTERESTS

Explorer will ask you what you like to see and create a personalized list of exhibits, which will also show up on the map. Pick as many interests as you want, and reset them any time to discover different parts of the Museum.



CREATURE FEATURES

With 70 featured exhibits in Explorer, you're bound to learn something new. Did you know the giant sequoia slice came in 12 pieces? That the *T. rex* has his teeth brushed? You'll get a whole new look at even the most iconic displays with videos, audio, and interactive content.

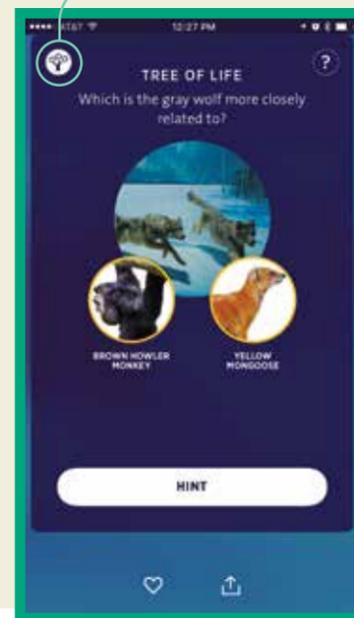
PRO TIP: Tap the heart icon in the top right corner of a feature to save an exhibit as your favorite.



TAP THE TREE OF LIFE

How closely related are you to a bear? A housecat? What about a platypus? Explorer lets you build a Tree of Life, just like those that biologists use to visualize the relationships between different species of mammal. By answering trivia questions, you'll learn more about how animals are related to one another. To start, just scroll down to a Tree of Life screen on any of the mammal exhibits that has **this icon**:

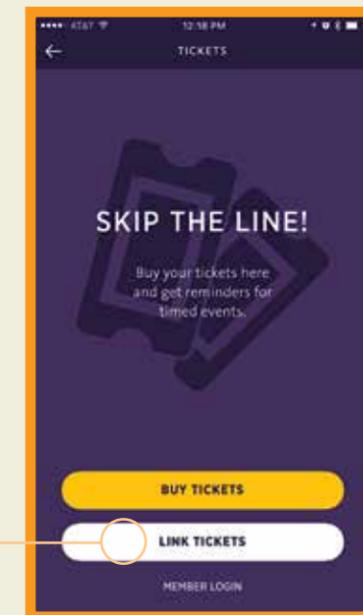
PRO TIP: When you're looking to fill out the Tree of Life, keep an eye out for modern mammals.



TAKE ON AVATOUR

Want to live like a grizzly bear without all that fur? With Explorer's Avatour feature, you can! Activate this augmented reality scavenger hunt in the Bernard Family Hall of North American Mammals, and you'll get to unlock five of the grizzly bear's animal superpowers to sniff out food, climb trees, and more. Don't hibernate on this opportunity to Be the Bear!

PRO TIP: If dinosaurs are more your style, check out Dino Detective Avatour on Explorer on the fourth floor.



LINK YOUR TICKET

Choose **Link Tickets** and type in the order number on your tickets to sync them on your trip to the Museum. You'll get notifications about show times, turn-by-turn directions, and more.

Download the free Explorer app, now available in Beta on the App Store or Google Play.

We want your feedback! Tell us what you think by emailing explorer@amnh.org

Explorer is supported by Bloomberg Philanthropies.

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



Cover illustration © J. McDonald



Dwarf crocodiles are among the smallest crocodile species. See these and other species live in *Crocs: Ancient Predators in a Modern World*, which opens May 28. See page 4 for more.

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-percent discount. Hours are subject to change.

MUSEUM SHOPS

The Museum Shop, Dino Store, Shop for Earth and Space, Cosmic Shop, The Secret World Inside You Shop, Dinosaurs Among Us Shop, and Online Shop (amnhshop.com) offer Members a 10-percent 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: **B** (weekdays) or **C** to 81st Street; **1** 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 can park for a flat fee of \$10 if entering after 4 pm. To receive this rate, show your membership card or event ticket when exiting the garage.

ACCESSIBILITY



For information on accessibility at the Museum, email accessibility@amnh.org or call 212-313-7565.