

 AMERICAN MUSEUM OF NATURAL HISTORY

ROTUNDA

Member Magazine
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DINOSAURS AMONG US

OPENS MARCH 21



*THE TITANOSAUR
ARRIVES THIS MONTH*

From the President

Ellen V. Futter



Last November, I was pleased to announce that the Museum's Trustees had approved an exciting conceptual architectural design for our new Gilder Center for Science, Education, and Innovation by MacArthur Fellow Jeanne Gang. The new facility will open in 2020 and be located on the Columbus Avenue side of the Museum campus.

Many of you who visit the Museum frequently or volunteer here know that we are bursting at the seams—last year, we welcomed a record five million visitors, and we are on pace to match or exceed that number this year. The new Gilder Center will help us accommodate and serve that growing audience, and its location will allow us to create new linkages with existing halls that currently terminate in dead ends. This will create more satisfying, effective, and intellectually cogent journeys of discovery through the Museum.

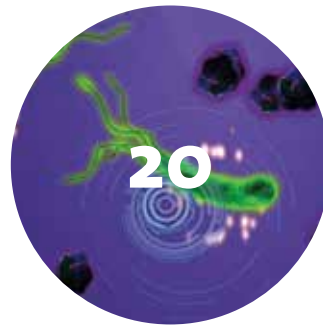
But it is not just about accommodating a

growing audience. We are building the new Gilder Center because our times demand it and technology makes possible new ways of seeing and exploring the Museum, both onsite and online. At a time when science literacy and science education are critical to our nation's future, the new Gilder Center will allow us to create new kinds of learning spaces and to employ new exhibition techniques to present science's 21st-century frontiers—on the microscopic level, at the ocean's depths, or inside the human body. And it will highlight and make accessible the Museum's research and collections—all to improve students' and the public's understanding of the world in which we live.

We are extremely excited to be moving forward with development of the innovative and important Gilder Center, and I look forward to keeping you updated in the months and years ahead.

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ROTUNDA

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Conceptual Design for Gilder Center Announced

In November, the Museum's Board of Trustees endorsed the conceptual design for the Richard Gilder Center for Science, Education, and Innovation, a new building that will invite visitors to experience the Museum not only as a place of public exhibitions but as an active scientific and educational institution.

"The Gilder Center embraces the Museum's integrated mission and growing role in scientific research and education and its enhanced capacity to make its extensive resources even more fully accessible to the public," said Museum President Ellen V. Futter.

The conceptual design for the Gilder Center links 10 Museum buildings through 50 connections, linking galleries and other spaces to vastly improve visitor circulation.

For additional information about the Gilder Center, visit amnh.org/GilderCenter.



The proposed façade of the Gilder Center from 79th Street and Columbus Avenue.

Coming Soon: The Titanosaur



A team member is dwarfed by a bone of the gigantic dinosaur excavated in Patagonia.

Something really, really big is coming to the Museum this month. Starting January 15, a cast of a 122-foot-long dinosaur—one of the largest ever discovered—will become the new centerpiece of the Miriam and Ira D. Wallach Orientation Center on the fourth floor. The new addition will graze the gallery's approximately 19-foot-high ceilings and will be just a bit too long to fit completely into the space. Instead, its neck and head will extend out toward the elevator banks, welcoming visitors to the "fossil floor."

The cast is based on a species of dinosaur so new that it has not yet been formally named by the paleontologists who discovered it in Argentina's Patagonia region in 2014. The remains were excavated in the desert near La Flecha—155 miles west of Trelew, Patagonia—by a team from the Museum of Paleontology Egidio Feruglio led by José Luis Carballido and Diego Pol, who received his Ph.D. degree here at the Museum.

Researchers have inferred that this dinosaur, a giant herbivore that belongs to a group known as titanosaurs, weighed in at around 70 tons. The gigantic animal lived in Patagonia between 100 and 95 million years ago, during the Late Cretaceous period, when the region was mostly forest.

"Titanosaur fossils have been unearthed on every continent, and an abundance of discoveries in recent years has helped us appreciate the deep diversity of this group," says Michael Novacek, the Museum's provost for science and curator in the Division of Paleontology.

The January unveiling of the Museum's new dinosaur is part of a special year of events, exhibitions, and digital offerings that highlight the dramatic developments in paleontology over the past few decades.

"Paleontology has become less geological and more biological in the last 20 years or so," says Mark Norell, Macaulay Curator and Chair of the Division of Paleontology, as well as the curator of the upcoming exhibition *Dinosaurs Among Us*. "Our access to advanced and extremely precise scientific tools like CT scanners and other x-ray imaging techniques lets us ask questions beyond 'what species is this, and when did it die?' Now we can look at complex topics like the evolution of dinosaur brains and the presence and color of dinosaur feathers."

In preparation for adding this colossal new exhibit, in September the Museum removed a life-sized—but, by comparison, diminutive—model of a juvenile *Barosaurus* that had been on display since June 1996.

The Titanosaur exhibit is free for Members or with Museum admission.

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

Photo: Dr. Alejandro Otero; Gilder Center rendering courtesy of Studio Gang Architects

ATTRACTIVE QUALITIES

The paper kite has characteristics that make it an especially popular choice for live butterfly exhibits. Its slow, lumbering flight makes it easy to study up close and to photograph. It's also "friendly"—tending to land on visitors and return to them again and again.

RARE PHOTO OP

When Carol Butler first began volunteering in *The Butterfly Conservatory*, she took a stunning photo of two paper kites in the vivarium. "Because they're toxic, those particular butterflies are apparently fearless," she says. "They will climb onto your finger like a pet parakeet." The photo, unusual because it shows the pair mating, ran on the cover of the *Journal of the Lepidopterists' Society* in December 2005.

HOT JOB LISTING

Butler is a co-author with Hazel Davies, director of living exhibits, of *Do Butterflies Bite?* She has worked for more than 10 years as a butterfly volunteer. Hers is the only volunteer opportunity at the Museum that mentions tolerating two hours of 80° F heat and 80 percent humidity. Or, as Davies puts it, "where it's summer all winter long!"

STORIED NAME

Idea is pretty straightforward: Latin for idea, archetype, even "ideal specimen." The specific name, *leuconoe*, has mythic connotations. In Greek mythology, Ovid used that name for one of three sisters turned into bats for refusing to worship the Greek god Dionysus. And Horace addressed an ode to Leuconoe about embracing the present.

DOZENS IN A DRAWER

One glass-topped shelf in the Museum's Entomology Department is filled with beautifully preserved paper kites. There are 38 in all, from various venues in Southeast Asia and with labels that list some of the most prominent 20th-century butterfly collectors, including Otto Buchholz, A.C. Frederick, and longtime Museum Curator Fred Rindge.

A Perennial Favorite

In *The Butterfly Conservatory*, it's easy to pick out the paper kites (*Idea leuconoe*) with their striking—dare we say sophisticated?—color pattern of black and white. The species, also known as the large tree nymph and the rice paper butterfly, is a perennial at the popular seasonal live-animal exhibition, which is overseen by David Grimaldi, curator in the Division of Invertebrate Zoology.

Denizens of dense forests and coastal mangrove swamps, paper kites range from Thailand to Malaysia, the Philippines, Taiwan, and Borneo. Their large wings—spanning up to 4.5 inches—allow them to glide, even sail through their habitat. While the wings are somewhat yellowish toward the body, the highly recognizable black and white markings may serve a protective purpose: warning off predators familiar with the species' unpleasant taste, caused by a toxin called danaidone that is passed by the male to the female during mating.

"It is very likely that they do advertise themselves," says Dr. Grimaldi, noting, however, that more typically animals that are warningly colored (aposematic) tend to have red, yellow, and black in a banded pattern, as seen in various insects, frogs, snakes, and butterflies.

The paper kite was first described in 1854 by German entomologist Wilhelm Ferdinand Erichson (1809–1848) from a specimen found on what was then the Philippine island of Luçon, today known as Luzon. Erichson was a physician who became enthralled with entomology during his university years, publishing his first entomological papers while still studying medicine. Although he died just short of turning 40, his career in entomology was exceptional, especially his role in the study of rove beetles, compiling the first complete worldwide classification of the family Staphylinidae.

"There's no doubt in my mind that Erichson was a genius and one of the most important, if not the most important, entomologists of all time," wrote Museum Curator Emeritus Lee Herman in the July 18, 2001, *Bulletin of the American Museum of Natural History*, comparing Erichson's effect on the field to Mozart's in music. "They both made an enormous impact in their respective fields, but they both died very young. We are left to guess what would have happened had they both had longer lives."

The Butterfly Conservatory: Tropical Butterflies Alive in Winter is open through May 29. Members enjoy special benefits.



Idea leuconoe

Cast of AMNH FARB 7224



Subway Coelophysis

In 1947, Museum paleontologist Edwin H. Colbert and his team came upon a veritable graveyard of the carnivorous dinosaur *Coelophysis bauri* at the New Mexico fossil site known as Ghost Ranch.

These early dinosaurs were small, fast, bipedal predators that likely chased down prey. In life, this *Coelophysis* probably looked much like a tiny *Tyrannosaurus* with long arms and a pointed face. The specimens Colbert found were remarkably well preserved, complete, and in many cases articulated.

Coelophysis is also among the bronze fossil casts you can see and touch in the 81st Street subway station, one of several created by the Metropolitan Transportation Authority Arts for Transit program as part of the station's renovation in 2000. That very cast, in fact, helped Museum researchers dispel a longstanding hypothesis about the species decades after its initial discovery.

For a long while, *Coelophysis* was thought to be a cannibal. This was due to the presence of tiny *Coelophysis* bones in the belly of one of the larger *Coelophysis* specimens turned up by Colbert and his team. But one night, while waiting for a train on the way to dinner, Sterling Nesbitt, then a Ph.D. student at the Museum, noticed something off about the cast when he glanced at some of the remains in the stomach.

"I just went over to look, and that's when I could see the head of the thigh bone," says Dr. Nesbitt, now a Museum research associate and professor at Virginia Tech. "And it looked like it wasn't a dinosaur."

Nesbitt's examinations of the subway cast prompted him and Macaulay Curator of Paleontology Mark Norell to take a closer look at the *Coelophysis* fossils in the Museum's collections, which forced them to rethink Colbert's initial hypothesis. Their conclusion: the bones in the stomach belonged to one of the many creatures in the same area more closely related to crocodiles, such as *Hesperosuchus agilis*.

"*Coelophysis* was just hungry," Dr. Nesbitt says. "It was eating another animal that lived at the same time, and it wasn't a cannibal!"

So next time you're in the subway, remember to take a good look at the casts adorning the walls. There's no telling what you might spot.

For more dinosaur discoveries, visit *Dinosaurs Among Us*, opening March 21. Members enjoy special benefits.

STATE PRIDE

The discovery of *Coelophysis bauri* was one of the most notable in the history of New Mexico, and so far, examples of the species have only been found within the state. Because of this connection, it was named the official state fossil of New Mexico in 1981.

PAINTER'S PARADISE

Famed painter Georgia O'Keeffe also spent many years at Ghost Ranch, and purchased a house there in 1940. In 2006, Nesbitt and Mark Norell, Macaulay Curator of Paleontology and Chair of the Division of Paleontology, named a species of archosaur found in the quarries there *Effigia okeeffeae* in her honor.

THEN AND NOW

Ghost Ranch is in a beautiful desert region that has been used as a setting in several Westerns. But when *Coelophysis* roamed the area, it was a much different place—a lush, wet river delta, dotted with lakes and replete with plant life.

FOSSIL FORGE

The four quarries at Ghost Ranch and other sites are rich in fossils of dinosaurs and their crocodylian relatives, often dating from the same time period. This suggests that this area was teeming with life for millions of years.

START SMALL

While we tend to think of dinosaurs as giants, they started small like *Coelophysis*, with enormous examples evolving later on. "This was one of the first dinosaurs, or at least it represents an early dinosaur body plan," says Nesbitt. "And this is probably what all early dinosaurs looked like."

Previous page © AMNH/H. Davies; this page © AMNH/M. Shanley

DINOSAURS AMONG US
OPENS MARCH 21



Dino

Brains

**NEW RESEARCH IS BLURRING
THE LINE BETWEEN DINOSAURS
AND MODERN BIRDS.**



An *Archaeopteryx* fossil that will be on display in *Dinosaurs Among Us*, set next to an illustration of the dinosaur in life.

The extinction of non-avian dinosaurs holds a stubborn place in our imagination, but in reality dinosaurs never vanished from the Earth. Many died out, certainly, but their evolutionary legacy lives on all around us in birds. Whether it's the pigeon on your windowsill or the chicken on your dinner plate, chances are you don't go a day without encountering dinosaurs.

This spring, the Museum will present *Dinosaurs Among Us*, a new exhibition detailing the unbroken line between ancient beasts and modern birds that is marked by features from feathers to fused clavicles. (That's right, turns out that, like the turkey, *Tyrannosaurus rex* had a wishbone—though we wouldn't recommend tugging on it.) And much of the work behind identifying and understanding these shared characteristics is being done by scientists trained or working at the Museum.

One area of focus? Flight. The occasional feathered-but-flightless specimen aside, the defining characteristic of birds is their ability to take to the skies. Flying, though, is tricky business. It demands synchronized activity in different areas of the brain, and that, in turn, means it requires a lot of, well, brains.

"Birds are doing a lot of different things with their brains during flight. For example, they have big optic lobes to help coordinate the visual information that they are collecting with the movements of their wings," says Dr. Amy Balanoff, a Museum research associate who studied with Mark Norell, Macaulay Curator and Chair of the Division of Paleontology, and is now a research instructor at Stony Brook University. "It's not surprising that they have really big brains."

While many of us grew up learning that dinosaurs were physical giants with puny brains, that's actually not the case, says Balanoff, especially for the animals that turn out to be most closely related to birds, such as tyrannosaurs and velociraptors. For the past eight years, Balanoff's work has focused on mapping the big brains of long-dead dinosaurs to find connections to modern birds.

Looking at dinosaur brains and comparing them to modern bird brains would be the ideal way to learn how the former evolved into the latter. Unfortunately, dinosaur brains were just as soft and mushy as our own, and thus not great candidates for preservation in the fossil record.

What did get preserved, though, were dinosaur bones. While they're not perfect, Balanoff and her colleagues can learn a lot about the volume and shape

of dinosaur brains—and how both changed over time—by examining their skulls using computed tomography (CT) scanners. Dinosaurs with particularly large brains left imprints on the inside of their skulls. CT scans allow scientists to create digital endocranial casts—detailed, 3D reconstructions of the interiors of fossilized skulls—for the first time, a thrilling feat that sheds new light on the evolutionary road from dinosaur brains to those of modern birds.

"Recent advances in medical imaging allow us to see what resided in the skull of an array of extinct animals," says Balanoff. "What is even more exciting is that once we know what the brain looked like, we can begin to make at least some broad inferences about their behavior?"

Using these brain imprints, Balanoff and colleagues can explore the external morphology—the outer shape—of the brain in greater detail than ever, gleaned intriguing new information about the volume and shape of different regions. For example, CT scanning has offered paleontologists a detailed view of the dinosaur cerebrum, a center for cognition and coordination in the brain. As it turns out, this region tends to be very large in dinosaurs that are closely related to birds.

In fact, Balanoff's research strongly suggests that these ancient avian relatives developed big brains long before flying was in the picture, laying the cerebral foundation that made the eventual development of powered flight possible.

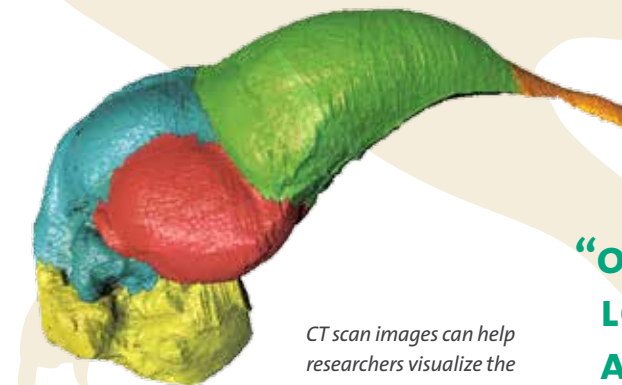
This means that, similar to the way bigger brains in primates served as a precursor to walking on two legs, bigger brains in dinosaurs primed them for flight.

In non-avian dinosaurs that are thought to mark the transition from dinosaur to bird, such as *Archaeopteryx*, the cerebrum is huge compared to the rest of the brain, a trend we see continued in modern birds whose brains are 40 to 60 percent cerebrum, compared to about 25 percent in tyrannosaurs. And the distinction between flight-ready animals like *Velociraptor* and a flying *Archaeopteryx* seems to be shrinking.

"For a long time, *Archaeopteryx* was considered the first bird, but all of those bird-like features appeared slowly, over the course of millions of years," Balanoff says, though pointing out that there is no longer a meaningful line demarcating where dinosaurs end and birds begin. "That's how evolution works. It can be a slow and messy process, but eventually we end up with the amazing diversity of things flying around us today?"

Balanoff hopes that future research in this field could shed light not only on the shape and size of dinosaur brains, but on how they influenced dinosaur behavior. Paleontologists already know that these prehistoric titans shared some behaviors with modern birds, such as brooding their eggs. Additional research may only make these ancient animals seem more familiar. Just picture a *Velociraptor*, dotted with feathers, sitting on a nest, its brain, if not its body, ready for takeoff. 🦖

Dinosaurs Among Us opens to the public on March 21 and is free for Members at the \$105 level and above.



CT scan images can help researchers visualize the brains of dinosaurs like *Archaeopteryx*.

"ONCE WE KNOW WHAT THE BRAIN LOOKED LIKE, WE CAN BEGIN TO MAKE AT LEAST SOME BROAD INFERENCES ABOUT THEIR BEHAVIOR."

TURKEY OR T. REX?

FEATHERS

Paleontologists believe that feathers initially developed as a means of keeping dinosaurs warm, but quickly developed into a tool for demonstrating suitability as a mate, a role they play in many bird species to this day.

EGGS

The dinosaur birthing process probably looked much like that of modern birds. Fossil evidence such as the *Oviraptor* nest on display in *Dinosaurs Among Us* shows that some dinosaurs laid eggs in a nest and incubated them to keep their young safe until hatching.

WISHBONE

A fused clavicle bone is called a furcula, but you may know it better as that Thanksgiving staple, the wishbone. This bone is a key to flight in birds, and also occurs in dinosaur species including *Velociraptor*.

NEW SPECIAL EXHIBITION

Dinosaurs Among Us will examine how one group of dinosaurs evolved into the fascinating living creatures we call birds. From flight to feathers, nests to wishbones, and brains to lungs, the exhibition will highlight the continuities between living dinosaurs—birds—and their extinct ancestors.

Curated by Mark Norell, Macaulay Curator and Chair of the Division of Paleontology, this exhibition will feature ancient, rarely seen fossils, and lifelike models, including a 23-foot-long feathered tyrannosaur (*Yutyrannus huali*), a small four-winged dromeosaur (*Anchiornis huxleyi*), and an extinct-dinosaur nest containing remains of the adult that guarded the hatchlings.

The Museum gratefully acknowledges the Richard and Karen LeFrak Exhibition and Education Fund.

Dinosaurs Among Us is proudly supported by Chase Private Client.

INTRODUCING MEMBER PREVIEW DAYS

FRIDAY, MARCH 18,
SATURDAY, MARCH 19,
AND SUNDAY, MARCH 20
10:30 AM TO 4:30 PM

FOR MEMBERS AT THE \$105 LEVEL AND ABOVE. ADMISSION BY TIMED ENTRY ONLY. TICKETS AVAILABLE STARTING MARCH 1 BY CALLING 212-769-5200.

Be among the first to explore the connection between ancient dinosaurs and modern birds at the new special exhibition *DINOSAURS AMONG US* before it opens to the public.

Join us for a weekend of exclusive Member Preview Days in the LeFrak Family Gallery beginning Friday, March 18.

Science teacher Christina Lee shows student Daisha Rivas how to find her pulse.



TEACHING

FROM THE

HEART⁺

A recent Museum graduate brings science to her middle school students.

Okay, we know learning can be fun, *but this much fun?* Christina Lee's general science class at Girls Prep Bronx Middle School is a riot of giggles as two dozen seventh graders run, jump, and dance in place. The goal: to get their hearts pumping. A buzzer sounds and the girls return to their seats. Suddenly, there is total silence—you could hear the proverbial pin drop—as they press a finger to their necks or hold a hand over their hearts to count their heartbeats for 30 seconds.

Lee urges them on with a hint of humor: "You're all alive. You all have a pulse."

They will repeat the pattern several times. And what they are getting, aside from some unexpected exercise, is an object lesson in the scientific method: State a hypothesis—the longer you exercise, the faster your heart beats—gather data, evaluate it, and draw a conclusion as to whether the hypothesis is true or not. Today, Lee is teaching students how to record and analyze results, a follow-up to a lesson about experimental variables. Over the next few months, she will be applying all of these fundamental principles to topics in chemistry, physics, and astronomy.

"Christina is incredibly creative," says Martha Zornow, principal of the new Bronx charter school, which is in its second year. "She does a very good job of designing experiments."

Two years ago, Lee, 26, was a member of the first group to graduate with the Museum's Master of Arts in Teaching (MAT) degree in Earth and space science. The innovative program, launched to address a shortfall of science teachers for grades 7–12 in underserved schools, began as a pilot in 2012 under the New York State Board of Regents. The only such program to be based at a museum, MAT offers participants a unique experience: a fully funded 15-month urban residency program co-designed by education specialists and scientists, with experience in the classroom and an intensive science course led by Museum researchers. Lee, for example, spent seven weeks during her second summer as a Kathryn W. Davis Graduate Teaching Fellow working with Curator James Webster and Dr. Patricia Nadeau, geologists in the Museum's Department of Earth and Planetary Sciences and MAT faculty members, researching the role different pressures and temperatures play in the behavior of crystallizing magma before a volcanic eruption.

“Our MAT graduates are teaching in high-need schools and in many cases are offering Earth science for the first time.”



Student Gabriela Encalada takes notes as Christina Lee leads her class at Girls Prep Bronx Middle School.

“It’s incredibly important for MAT candidates to be able to take part in the behind-the-scenes process of science,” says Nadeau, who is a Kathryn W. Davis Postdoctoral Scholar. “Everything that’s in the textbooks they use to teach their students is the result of someone’s hard work in a lab or out in the field, so it’s great that they get a chance to be directly involved in that process before heading off to their classrooms.”

The value of this approach is proven in practice. “The principals are very excited about the passion for science and depth of knowledge our graduates are bringing into their classrooms,” says Dr. Rosamond J. Kinzler, co-director of the MAT program and senior director for science education at the Museum.

When the current crop of 16 teachers-in-training graduate from MAT this year, they’ll join the ranks of 50 MAT graduates already teaching in New York state schools. While it is still too soon to appraise the full impact of the program, preliminary results are promising. Not only has the number of science teachers increased in target schools, the number of students in those schools taking the Earth Science Regents exam has more than doubled—an indication that MAT teachers are having a positive effect on science literacy where it is most needed.

“Our MAT graduates are teaching in high-need schools and in many cases are offering Earth science for the first time,” says Dr. Kinzler. “They are teaching students who are disproportionately poor, under-represented in the sciences, and in limited English proficiency programs or special education programs. Given that Earth science can be a gateway to the more advanced courses students need for today’s careers in science and technology, it is essential that all students have the opportunity to take it.”

Lee herself is especially interested in motivating girls to pursue science. While girls appear to be catching up with boys in math and science through high school, statistics show that gender differences emerge at the college and postgraduate levels, with far fewer women than men attaining degrees in engineering, computer science, math, and the physical sciences. The numbers are even more pronounced among black and Hispanic women. Lee, who taught Earth science in her previous job at Sunset Park High School in Brooklyn and is now covering general science, chemistry, physics, and astronomy, hopes to help bridge the gap.

“This being an all-girls’ school was a deciding factor in my coming here,” says Lee, who earned her undergraduate degree in geology at Bryn Mawr, a women’s college where the geology department was founded by Florence Bascom, the first woman to earn a Ph.D. degree from Johns Hopkins University.

“The women-only education at Bryn Mawr really shaped me,” says Lee. “In most universities, science is driven by male students, but when you erase that it’s more comfortable. I definitely see that with these girls. They are normally so self-conscious but because there are no boys, they aren’t afraid to take chances.”

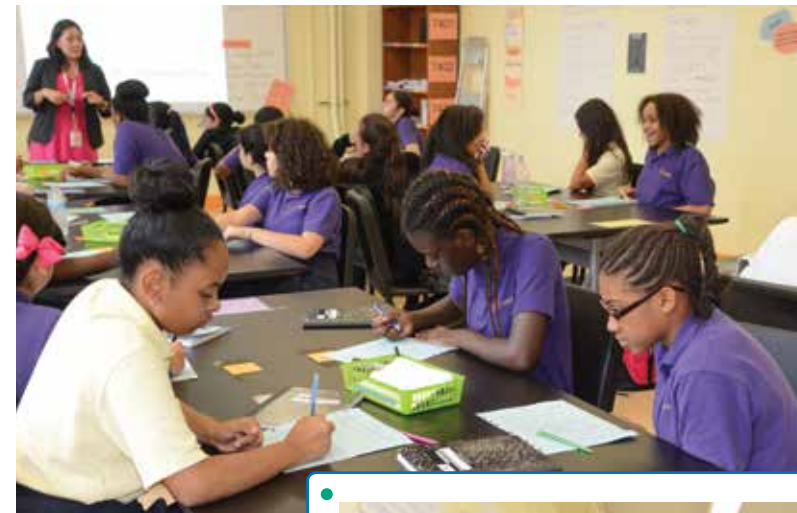
Support Systems

A key component of the Museum’s MAT program is training teachers through real classroom experience—and with plenty of support along the way.

Studies show that between 40 and 50 percent of new teachers quit the profession within five years. But the Museum’s MAT graduates get exceptional professional development for two years with a system called “induction,” in which they are supported by staff from the Museum’s Gottesman Center for Science Teaching and Learning. Staff visit the new teachers at their schools, mentor them, and help them determine the best ways to achieve specific objectives.

“The goal is to help them to be effective faster,” explains Cristina Trowbridge, one of the induction specialists. “Teaching is a career, and nobody gets it right the first time out. But when you have support—and the research shows this—you make bigger leaps. You grow so much faster.”

“It makes it a lot easier than if you’re on your own,” agrees Lee.



After measuring their pulses, students record the results, including at the front table, clockwise from left, Keanna Villega, Kathryn Akurut, and Gerilynn Felicia-Norton.



Dancing helps students Vanessa Lois, Daisha Rivas, and Jade Aguasanta pump up their heart rates.

“Christina is really aligned with our goals,” says Zornow. “We want girls to experience science, to be hands-on in science, to do science. To learn to formulate a question and test it.”

Back in the classroom, exactly to that end, the girls calculate their results after measuring beats per minute following 10, 20, and 30 seconds of exercise. Lee writes the numbers on a graph projected on a white board. Averaging to account for errors, the heartbeats per minute for 10 seconds of moving average 95. After 20 seconds, 114 beats per minute. After 30 seconds, 149. Clearly, the trend is moving in the direction of proving the hypothesis. But they still need to collect more data, so the conclusion will wait for another day. The girls gather their work sheets, stow them for further research, and move on to their next class.

Behind them on the classroom wall is a poster with a quote from someone else who knew something about women and striving to make the most of oneself, Eleanor Roosevelt. “The future,” she said, “belongs to those who believe in the beauty of their dreams.”

With deepest appreciation, the Museum acknowledges Kathryn W. Davis for her generous founding support of the Master of Arts in Science Teaching (MAT) Program.

Leadership support for the MAT program is provided by The Shelby Cullom Davis Charitable Fund.

The MAT program is supported in part by the New York State Education Department, the National Science Foundation under Grant Numbers DRL-1119444 and DUE-1340006, and the U.S. Department of Education under Grant Number U336S140026.

Photos © AMNH/R. Mickens

Know an Aspiring Science Teacher?

Spread the word: applications for the MAT program’s Class of 2017 are due January 31.

The 15-month MAT program includes two summer residencies at the Museum: a summer assistant-teaching with instructors in the Museum’s Youth Initiatives programs and a seven-week science practicum with Museum curators and postdoctoral fellows. During the academic year, while completing more coursework, MAT candidates co-teach four days per week in partner schools, mentored by an experienced classroom teacher. They are also supported by a faculty member and receive additional support throughout their first two years of independent teaching (see Support Systems sidebar).

Tuition for the 15-month MAT program is free and candidates receive a stipend. Graduates must commit to four years of teaching in underserved schools in New York State.

Visit amnh.org/learn-teach/mat for more information.

Programs and Events

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

For updates and reminders via email, 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 December 1. Please check amnh.org/calendar for updates.

JANUARY

SciCafe: Amazing Anemones
Wednesday, January 6
7 pm

Free for 21+ with ID
Join Associate Curator **Estefanía Rodríguez** for an exciting underwater journey to meet sea anemones and learn how much there is still to be discovered about these animals that live in every known marine environment.



Walk on the Wild Side
Eight Wednesdays,
January 6–February 24
8–9:30 am

Free for Adventurer-level and above; registration required; call 212-769-5606
Join a fitness experience like no other! After a brisk Wednesday morning walk through the Museum's halls, enjoy a light breakfast in the Akeley Hall of African Mammals.

Family Astronomy
Thursday, January 7
6:30 pm
\$10

Join us in the Hayden Planetarium as we teach our youngest astronomers about the methods and tools used to observe the night sky, followed by a viewing through telescopes on the Arthur Ross Terrace, weather permitting.

Frontiers Lecture: Searching for the Oldest Stars
Monday, January 11
7:30 pm
\$12

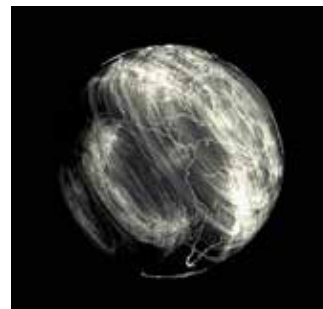
MIT astronomer **Anna Frebel** explains the ongoing search for rare and ancient “relic stars” and how this work reveals new details about the early history of the universe.

Sidney Horenstein Tours North America
Tuesday, January 12
6–7:30 pm
\$25

Geologist **Sidney Horenstein** takes visitors on a tour of the unique landscapes of North America. Learn about volcanoes, glaciers, canyons, and mountain ranges in the magnificent Bernard Family Hall of North American Mammals.

SeismoDome: Sights and Sounds of Earthquakes and Global Seismology
Thursday, January 14
7 pm

Free; registration required; call 212-769-5200
Experience immersive displays of earthquakes and seismic waves from the last decade, viewed both from space and deep inside the globe in the Hayden Planetarium.



The Titanosaur
Opens Friday, January 15
Free for all Members

Another must-see exhibit is coming to the Museum's world-famous Fossil Halls. See a cast of a 122-foot-long dinosaur, a species so new that it has not yet been formally named by the paleontologists who discovered it.

Exhibitions

Admission is by timed entry only.

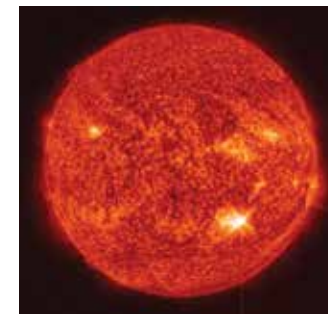
Dinosaurs Among Us
Opens to the public March 21
Free for Members at the \$105 level and above

Dinosaurs Among Us will feature ancient fossils and lifelike models to show how one group of dinosaurs evolved into the fascinating creatures we call birds. Member Preview Days begin Friday, March 18.



The Secret World Inside You: The Human Microbiome
Free for Members at the \$105 level and above

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.



Journey Around the Sun
Tuesday, January 26
7 pm
\$12

Ted Williams will guide you on the Earth's 586-million-mile voyage around the Sun and prepare you for the astronomical highlights of the coming year in the Hayden Planetarium.

The Art of Diorama
Six Thursdays, January 28–March 3
7–9:30 pm
\$195

Discover how dioramas are made from start to finish, and hear behind-the-scenes stories about how they came together, as Museum exhibition specialist **Tom Doncourt** leads an after-hours look at our legendary dioramas.

Our Earth's Future: Understanding Climate Science and Sea Level Rise
Saturday, January 30
9 am–4 pm
\$85

Dr. Debra Tillinger will compare human-induced sea level rise, a consequence of global warming, with the natural variability in sea level height caused by El Niño and other phenomena. Participants will come away from this day-long seminar fluent in the science of climate change.



Escape to Mexico and Central America Tour
Saturday, January 30
2–3:30 pm
Free; registration required; call 212-769-5200

Escape the winter cold on a guided tour of the Hall of Mexico and Central America, where you'll see the Aztec Stone of the Sun and other amazing artifacts from the Museum's collections.



Opulent Oceans
Free for all Members
This exhibition features illustrations of sea creatures by generations of explorers, from rare and beautiful scientific works in the Museum Library's collections.

FEBRUARY

Winter Lunchtime Bird Walks in Central Park
Four Tuesdays, February 2–23
Noon–1:30 pm
\$50

Observe owls, hawks, and woodpeckers in the woods, finches and sparrows in the fields, and ducks and gulls in the lakes as ornithologist **Paul Sweet** guides you through Central Park to observe the varied bird species that make New York City their winter home.

SciCafe: Mending a Broken Heart
Wednesday, February 3
7 pm

Free for 21+ with ID
Stem cell researcher **Jeffrey Karp** explains how scientists are drawing inspiration from nature, building on the biology and chemistry of gecko feet, spider webs, porcupine quills, and more. Learn how biologically inspired glue can connect devices in a beating human heart.

Frontiers Lecture: New Horizons: The Pluto Encounter
Monday, February 8
7:30 pm
\$12

This summer, NASA's New Horizons spacecraft captured incredibly detailed images of Pluto, revealing a planet alive with geological activity! Join New Horizons' Deputy Project Scientist **Cathy Olkin** and the Museum's Director of Astrovisualization **Carter Emmart** as they share the latest scientific findings and high-resolution images from the edge of our solar system.



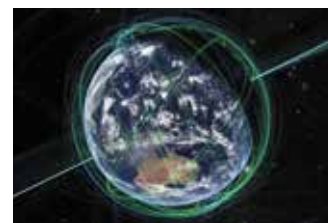
Countdown to Zero: Defeating Disease
Free for all Members

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.



Romance Under the Stars
Sunday, February 14
6 pm, 9:30 pm
\$125 (includes 90 minutes of open bar and hors d'oeuvres)
 Celebrate Valentine's Day with a unique night at the Hayden Planetarium, including cocktail hour in the Hall of the Universe complete with open bar, hors d'oeuvres, live music, and some stellar romance stories from the ancient past.

Adult Digital Flight School
Wednesdays, February 17–March 30
6–8 pm
\$395
 Amaze your friends and family by taking the controls of the Hayden Planetarium and lead your own tour through the cosmos. In this seven-week course, **Brian Abbott** and **Nathan Bellomy** train you to lead your own live presentation for invited guests in the Hayden Planetarium dome.



Sackler Brain Course: The Neurobiology of Attachment
Saturday, February 20
9 am–4 pm
\$85
 What happens in babies' brains to facilitate attachment to their caregivers? How do these essential and emotional connections form? In this one-day course, a group of experts will lead you through recent insights into the neurobiology and behavior of early childhood attachment.

Spotlight Asia
Sunday, February 21
Noon and 3 pm
Free for all Members
 Award-winning **Nai-Ni Chen Dance Company** rings in the Year of the Monkey, a year characterized by cleverness, curiosity, and playful mischief. The Museum's Lunar New Year festival celebrates Asian art and culture through contemporary choreography, traditional storytelling, and hands-on activities taught by local artisans.

The Secret World Inside You: Master Class
Five Mondays, February 22–March 21
6:30–8:30 pm
\$240
 Get hands-on with the human microbiome inside the Museum's fall exhibition, *The Secret World Inside You*, as you learn from leaders in the field about the present and future of microbiome research and conduct experiments to discover your own microbial signature!



A Brief History of the Universe
Tuesday, February 23
7 pm
\$12
Emily Rice and **Brian Levine** will break the laws of physics in the Hayden Planetarium, travelling back in time to the Big Bang to understand how it shaped the universe, then return to Earth with a new comprehension of how cosmological history has led us to where we are now.



Baby Animals Tour
Sunday, February 28
10:30 am–noon, 1:30–3 pm
Free; registration required; call 212-769-5200
 See how newborn birds, gorillas, dinosaurs, and other baby animals learn to survive and thrive during this special tour of the Akeley Hall of African Mammals, with stops in the bird and dinosaur halls.



Please check amnh.org for Member ticket prices for live animal exhibits and giant-screen 2D and 3D films.
The Butterfly Conservatory
 Housed in a vivarium that approximates their natural habitat with live flowering plants, butterfly species in this ever-popular exhibition include iridescent blue morpho butterflies, striking scarlet swallowtails, and large owl butterflies.



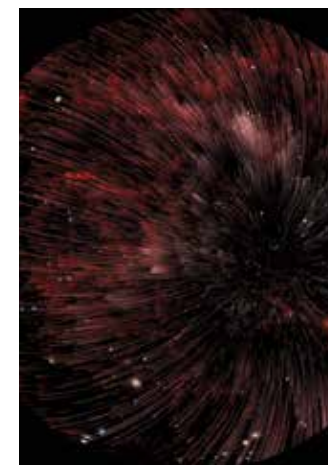
Jean-Michel Cousteau's Secret Ocean
Closes in February. Check amnh.org for Spring film. *Jean-Michel Cousteau's Secret Ocean* introduces audiences to more than 30 marine species and behaviors captured for the first time thanks to groundbreaking advances in underwater filming. Narrated by renowned oceanographer Sylvia Earle, this 40-minute giant screen film is showing in 2D and 3D.

MARCH



SciCafe: Swarms of Aerial Robots
Wednesday, March 2
7 pm
Free for 21+ with ID
 Join roboticist **Vijay Kumar**, UPS Foundation Professor at the University of Pennsylvania, as he describes the advantages of using tiny, autonomous, aerial robots for search and rescue, first response, and precision farming.

The Cosmic Web: Mysterious Architecture of the Universe
Monday, March 14
7:30 pm
\$12
 Distinguished astronomer **J. Richard Gott** discusses how ambitious telescope surveys are transforming astronomy, and what the structure of the so-called "cosmic web" says about the origins—and fate—of the universe.



Game Night Gone Wild
Tuesday, March 15
7-9:30 pm
\$35 (two drinks included)
21+ with ID
 Fire up your neurons with a cocktail in hand for an exciting evening of digital and physical games that tease, challenge, and entertain your brain. Test your cognitive skills while scientists explain what games can teach us about our complex, mysterious, magnificent brains.



Animal Drawing
Eight Thursdays, March 17–May 5
7-9 pm
\$160
 The celebrated dioramas, dinosaur exhibits, and halls of the Museum serve as the settings for an intensive after-hours drawing course with illustrator and naturalist **Patricia Wynne**.

All experience levels welcome, materials included, class size limited.

Member Preview Days: Dinosaurs Among Us
Friday, March 18 – Sunday, March 20
10:30 am–4:30 pm
Free for Members at the \$105 level and above. Reserve tickets by calling 212-769-5200 starting March 1.
 Explore the newest exhibition, *Dinosaurs Among Us*, before it opens to the public!

Sun-Earth Day
Saturday, March 19
11 am–5 pm
Free
 Join us as we explore the special relationship between Earth and the Sun and learn about the delicate balance that makes our planet the perfect place to call home. Talk with scientists, look through telescopes, and engage in hands-on activities at this family-friendly event.



Family Astronomy
Saturday, March 19
6:30 pm
\$10
 After Sun-Earth Day, join us in the Hayden Planetarium as we teach our youngest astronomers about the methods and tools used to observe the night sky, followed by a viewing through telescopes on the Arthur Ross Terrace, weather permitting.

Behind the Scenes: Paleontology
Wednesday, March 23
6:30 pm, 7 pm, 7:30 pm (Hour-long tours)
\$30
 Take part in this exclusive opportunity to visit the collections of the Museum's Division of Paleontology. Museum staffers will demonstrate how fossils are preserved and maintained while guiding you through the preparation lab and the collection storage spaces. See how scientists use 3D images to study paleoecological environments. View microfossils under a microscope and learn their significance in environmental studies.

Attendees must be at least 10 years old.

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.

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.

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

Credits continue on page 18.

The Scoop on Poop Tour: Scatology for Adults

Saturday, March 26
10:30 am–noon
 Free; registration required; call 212-769-5200
 Everybody poops, and over the years, people around the world have exploited excrement for many purposes, using it in agriculture, beauty products, medicine, and even as food. Join a volunteer guide for a ‘not for children’ tour and discussion of excrement.

Morning Bird Walks in Central Park

Eight-week series starting **Tuesday, March 29, Wednesday, March 30, Thursday, March 31, or Friday, April 1**
7 am (Fridays start at 9 am)
\$85

Observe the exciting spring migration of birds in Central Park with ornithologists **Paul Sweet** (Tuesdays, 7 am, and Fridays, 9 am) and **Joseph DiCostanzo** (Wednesdays and Thursdays, 7 am). Learn how to use field marks, song, habitat, and behavior to identify birds including warblers, thrushes, tanagers, and orioles as they pass through Central Park en route to their summer homes.



Spring Lunchtime Bird Walks in Central Park

Session 1:
Four Tuesdays, March 29–April 19
Session 2:
Four Tuesdays, April 26–May 17
Noon–1:30 pm
\$50

The early bird catches the worm, but you don’t have to miss spring migration if you can’t make the morning walks. Join **Paul Sweet** for lunchtime bird walks and observe the vibrant colors of warblers, tanagers, and orioles among the many species that pass through Central Park.

The Universe in Time

Tuesday, March 29
7 pm
\$12
 Throughout the vast and expanding universe, stars revolve and evolve, galaxies collide and merge with one another. Join **Brian Abbott** and **Brian Levine** in the Hayden Planetarium as they discuss how stars, galaxies, and the universe took shape, and how they evolve through time.



Field Trip to the Moon

Thursday, March 31
6–6:30 pm,
6:45–7:15 pm
\$12.50 adults, \$8 children
 Power up your imagination and take a virtual trip to the Moon from the Hayden Planetarium! A live presenter will guide you on your journey through space—like a real astronaut. You’ll experience a NASA rocket launch, view Earth from space, and perhaps make some starry discoveries along the way.

Credits

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

The Museum gratefully acknowledges The Mortimer D. Sackler Foundation, Inc. for its support to establish the Sackler Brain Bench, part of the Museum’s Sackler Educational Laboratory for Comparative Genomics and Human Origins in the Spitzer Hall of Human Origins, offering ongoing programs and resources for adults, teachers, and students to illuminate the extraordinary workings of the human brain.

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

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 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.

JANUARY

6 WEDNESDAY
 SciCafe: Amazing Anemones
After-Hours Program

Walk on the Wild Side
Member Program
 Eight Wednesdays through February 24

7 THURSDAY
 Family Astronomy
Hayden Planetarium Program

11 MONDAY
 Searching for the Oldest Stars
Frontiers Lecture

12 TUESDAY
 Sidney Horenstein Tours North America
Member Program

14 THURSDAY
 SeismoDome: Sights and Sounds of Earthquakes and Global Seismology
Special Event

15 FRIDAY
 The Titanosaur on view

20 WEDNESDAY
 The Year in Review with Neil deGrasse Tyson
Hayden Planetarium Program

26 TUESDAY
 Journey Around the Sun
Hayden Planetarium Program

28 THURSDAY
 The Art of Diorama
Adult Course
 Six Thursdays through March 3

30 SATURDAY
 Our Earth’s Future: Understanding Climate Science and Sea Level Rise
Adult Course

Escape to Mexico and Central America Tour
Member Program

FEBRUARY

2 TUESDAY
 Winter Lunchtime Bird Walks in Central Park
Nature Walk
 Four Tuesdays through February 23

3 WEDNESDAY
 SciCafe: Mending a Broken Heart
After-Hours Program

8 MONDAY
 New Horizons: The Pluto Encounter
Frontiers Lecture

14 SUNDAY
 Romance Under the Stars
Hayden Planetarium Program

17 WEDNESDAY
 Adult Digital Flight School
Adult Course
 Seven Wednesdays through March 30

20 SATURDAY
 Sackler Brain Course: The Neurobiology of Attachment
Adult Course

21 SUNDAY
 Spotlight Asia
Cultural Program

22 MONDAY
The Secret World Inside You: Master Class
Adult Course
 Five Mondays through March 21

23 TUESDAY
 A Brief History of the Universe
Hayden Planetarium Program

28 SUNDAY
 Baby Animals Tour
Member Program

MARCH

2 WEDNESDAY
 SciCafe: Swarms of Aerial Robots
After-Hours Program

14 MONDAY
 The Cosmic Web: Mysterious Architecture of the Universe
Frontiers Lecture

15 TUESDAY
 Game Night Gone Wild
After-Hours Program

17 THURSDAY
 Animal Drawing
Adult Course
 Eight Thursdays through May 5

18 FRIDAY
 Member Preview Begins: *Dinosaurs Among Us*
Member Program

19 SATURDAY
 Sun-Earth Day
Hayden Planetarium Program

Family Astronomy
Family Program

23 WEDNESDAY
 Behind the Scenes: Paleontology
Member Program

26 SATURDAY
 The Scoop on Poop Tour: Scatology for Adults
Member Program

29 THURSDAY
 The Universe in Time
Hayden Planetarium Program

Morning Bird Walks in Central Park
Nature Walk
 Nature Walk Eight week series

Spring Lunchtime Bird Walks in Central Park
Nature Walk
 Four Tuesdays, March 29 through April 19

31 THURSDAY
 Field Trip to the Moon
Hayden Planetarium Program

©AMNH/C. Chesek, D. Finnin, R. Mickens, M. Shanley 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) Journey Around the Sun, (NASA/SDO) and Pluto Encounter (NASA/JHUAPL)

MicroRangers To The Rescue!

A new mobile app from the Museum brings an invisible world to life



Microbiologist

Download *MicroRangers* and scan the image above to meet a character from the game.



The world's most amazing ecosystems are in danger, and it's up to you to save them! That's the premise of *MicroRangers*, a new mobile game for Android and iOS smartphones that uses augmented reality to turn the Museum's first floor into a series of animated adventures that highlight how microbial life can impact the health and security of larger life forms like towering trees, charismatic animals, and, yes, humans.

"Most biodiversity is too small to be seen without a microscope. But those microbes are just as important as other forms of life in keeping ecosystems healthy," says Susan Perkins, who advised on *MicroRangers* and is co-curator of *The Secret World Inside You* exhibition about the human microbiome.

The game has been in development since 2014, as Museum educators have worked with high schoolers in Museum programs as well as with game designers at Playmatics and Geomedia to create a unique experience based on iconic exhibits and dioramas that many longtime Members know well—but, through *MicroRangers*, may rediscover in a new way.

"Well-designed games are powerful learning spaces, where players can learn through experimentation and failure, which is the nature of science as well," says Barry Joseph, associate director for digital learning at the Museum. "They also serve as great tools for collaborative learning alongside friends and family!"

Game play begins in the Hall of Biodiversity, which serves as a sort of home base. From there, players are dispatched to solve science-based mysteries in the Milstein Hall of Ocean Life, Hall of North American Forests, and the Bernard Family Hall of North American Mammals, with directions, clues, and three-dimensional animations popping up on their phones.

Nine levels, each posing different challenges and introducing different lessons based in the Museum's halls, create new and interesting connections that offer a different way to interact with even the most familiar exhibits.

One challenge in the Hall of North American Forests, for instance, pits players against the scourge of chestnut blight. Using their phones, players eliminate the devastating fungus from trees that spring to digital life all around the hall. Augmented reality coins, available at the Membership desk in the Theodore Roosevelt Rotunda, help bring characters in the game, like the animated scientists you meet on missions, to life.

"The way we're using augmented reality will mean the game is all around you," says Hannah Jaris, a senior coordinator who helped lead the development of *MicroRangers*.

With scientist characters guiding players through a diversity of ecosystems, newly minted *MicroRangers* will also be able to learn about the tools and techniques researchers use to study life in forests, on coral reefs, and everywhere in between.

Many players will play just the first level to get a taste of the



In prototypes of *MicroRangers*, youth program participants and Museum staff stood in for characters in the game.

game—it takes about 20 minutes, Joseph estimates—while others could play through to completion, exploring all three halls in depth over the course of several hours. And frequent visitors like Members can play over the course of multiple trips to the Museum at any pace they choose. Whichever way visitors play, says Joseph, *MicroRangers* feels like a full game experience for both casual players and more dedicated gamers.

Museum educators collaborated on *MicroRangers* with teenagers, the app's natural audience, on everything from content and game design to early voice-overs for the game's characters—in large part, Joseph says, to show that the Museum is not just a place youth can come to learn, but one where they can contribute.

"From the very start, we wanted young people to be not just participants in a focus group, but co-designers of their own science education," says Joseph.

And while *MicroRangers* has already been a learning experience for the youth and staff who helped develop the game, designers say the ways people play the game will provide design lessons for the future. How users are playing the game and what activities and interactions they embrace or ignore will help to shape the experiences offered by future Museum games.

"The ideal Museum visit is also the ideal game," says Joseph. "You connect with exhibits, connect with the people around you, and learn something new."

MicroRangers is free and available to download from the iOS App Store and Google Play. To learn more, visit amnh.org/MicroRangers, and visit the Membership desk in the Theodore Roosevelt Rotunda to pick up augmented reality coins to play the game. (Limited quantities, while supplies last.)

MicroRangers is generously supported by a grant from the Anna-Maria and Stephen Kellen Foundation.

MORE GAMES FROM THE MUSEUM

From CD-ROMs to space flight simulators to card games produced for special exhibitions, the Museum has been developing engaging, educational interactive experiences for decades. *MicroRangers* is the latest, but here are a few other new games now out from the Museum:

GUTSY

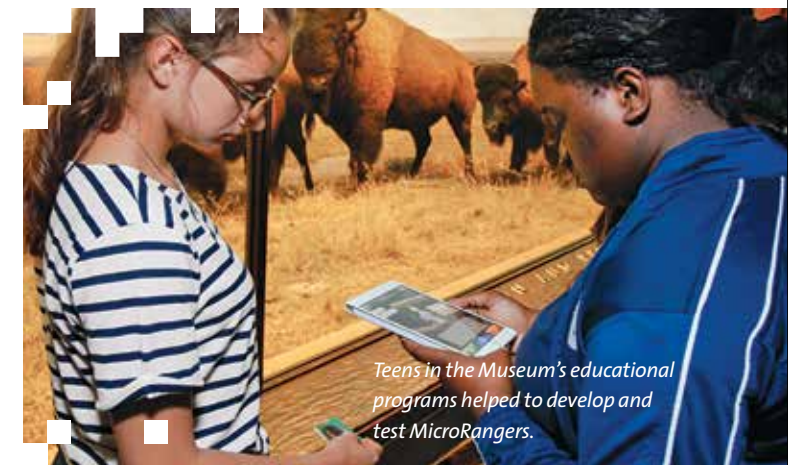
A card game developed as a companion to *The Secret World Inside You*, *Gutsy* lets you take lessons about the microbiome home and share them with others. Learn more about the way that different microbes interact in the human body and get an up-close and personal understanding of the many species that call you home. Developed by veteran game designers and Curator Susan Perkins, *Gutsy* is a fast-paced card game that combines education and entertainment. Now available in Museum shops.

PTEROSAURS: THE CARD GAME

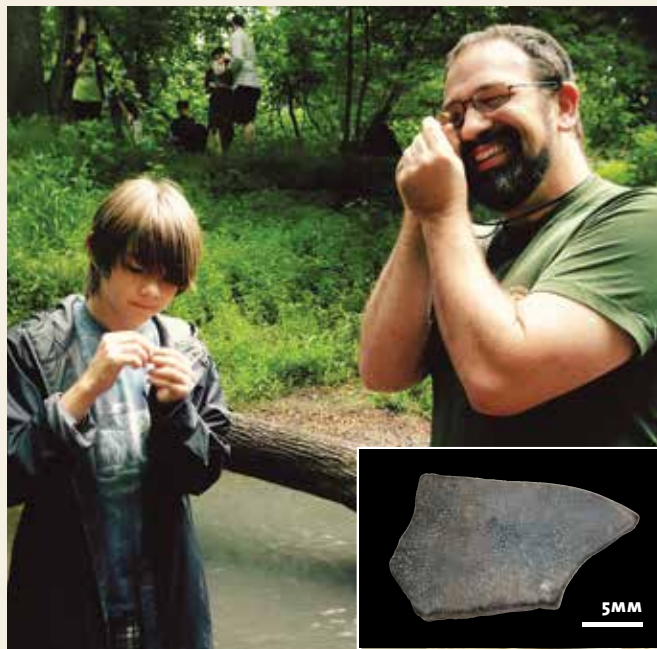
Developed alongside the 2014 special exhibition *Pterosaurs: Flight in the Age of Dinosaurs*, *Pterosaurs: The Card Game* challenges players to build functioning food chains using a shared deck of 51 cards representing various ancient forms of life, including flowers, fish, and the flying phenoms of the title. The player with the most chains at the end of the game wins! Visit bit.ly/PterosaurGame to download the game for free.

OLogy

Digital learning has been an area of focus since the launch of the Museum's award-winning science website for kids, *OLogy*, where interactive lessons and web-based games have been available to anyone with an Internet connection since 2000. Visit bit.ly/MicroBIOlogy to see *OLogy's* Microbiology section!



Teens in the Museum's educational programs helped to develop and test *MicroRangers*.



Carl Mehling takes a look at a fossil found by Museum Member Braden Vande Plasse.

An Enigmatic Fossil Fragment

Not all fossil discoveries take place at far-flung locations.

Last June, paleontologist Carl Mehling was leading a Member trip to Big Brook, New Jersey's famous Late Cretaceous site, when 13-year-old Braden Vande Plasse showed him a small piece he'd found. At first, says Mehling, he was ready to dismiss it as "just a rock," but a closer look revealed "a very clear biological structure."

"My gut was leaning towards a bone or some other vertebrate structure," says Mehling, who's been collecting fossils in the area since 1988 but was still stumped as to what kind of animal this may have been. "I asked Braden if he would be willing to donate to the Museum—and thankfully, he was."

Back at the Museum, Mehling began his investigation. Since fishes are the most common vertebrate fossils at Big Brook, he first turned to Curator John Maisey, a fossil fishes expert. With a quick look under a dissecting microscope, Dr. Maisey confirmed the piece was a tooth or a tooth plate. A tip from Maisey's Ph.D. student Allison Bronson led Mehling to realize that the tooth plate might belong to a Mesozoic lungfish—and after consulting the Museum's collection of fossil lungfish teeth, he decided there were some good matches to this new fossil.

But several days later, a serendipitous email from a Texas researcher about a different fossil specimen that bore a strong resemblance to the Big Brook find led Mehling to a different conclusion: Vande Plasse's fossil was likely a fragment of a tooth plate from some as-yet unidentified, likely marine, Cretaceous fish rather than a lungfish. Mehling is currently preparing a paper that may help him find other experts to identify the find.

Behind the Scenes: Fossil Prep

In more than a century of fossil collecting, Museum scientists have brought back hundreds of thousands of specimens: dinosaurs, birds, fishes, mammals, and more from throughout Earth's history and from every corner of the globe.

Just discovering a specimen, though, doesn't make it useful to science. "One of the things people don't understand about collecting fossils is that we go out on an expedition, and it's hard work—but what really takes the time is the preparation to expose these things," says Mark Norell, Macaulay Curator and Chair of the Division of Paleontology.

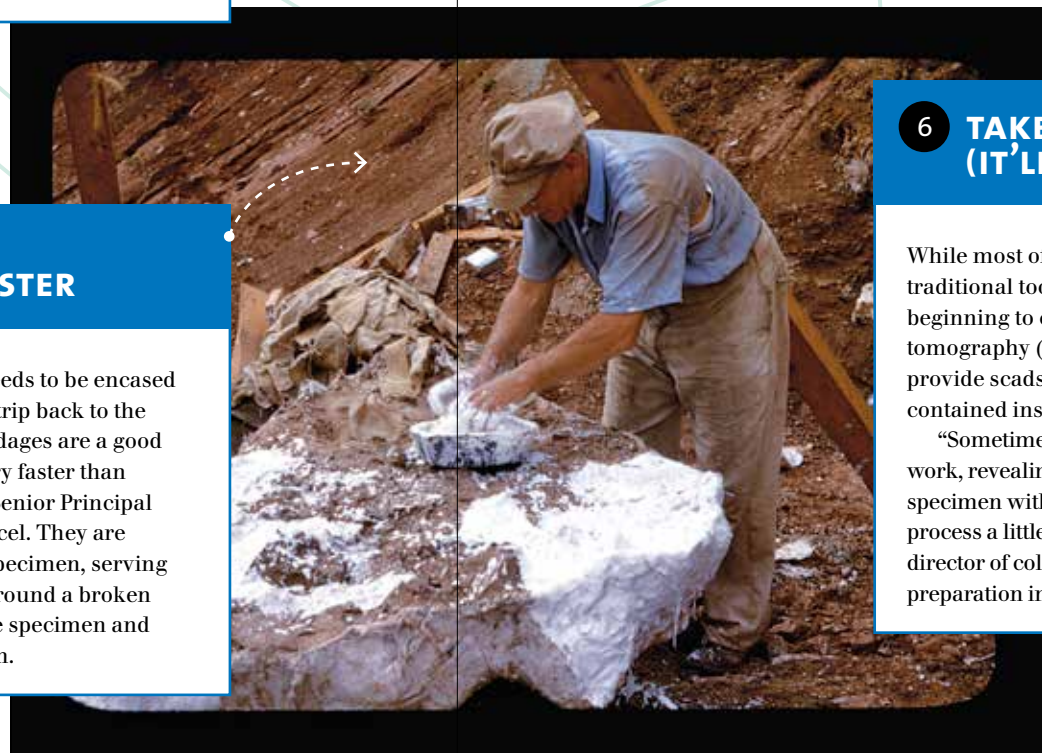
Here's how a specimen goes from being encased in stone to ready for the spotlight—or at least the microscope.

1 TAKE NOTE

First things first: paleontologists record everything about the condition of a newly uncovered fossil. They record for posterity where, when, and by whom a fossil was excavated, indicate estimates of how many fossils are in a given block, and offer preliminary identification of the animal.

2 PROTECT WITH PLASTER

A fossil find usually needs to be encased in plaster to make the trip back to the Museum. "Plaster bandages are a good choice because they dry faster than regular plaster," says Senior Principal Preparator Ana Balcarcel. They are wrapped around the specimen, serving the same purpose as around a broken limb, immobilizing the specimen and protecting it from harm.



Museum paleontologist Carl Sorensen prepares a fossil block for shipment back to the Museum.

3 HANDLE WITH CARE

Fossil finds are packed in wooden and metal crates and surrounded with another layer of packing material—often the same newspaper that might protect your china on the way to a new apartment—and shipped back to the Museum.

5 SPLIT TOOLS

Tools of the trade range from needle-like chisels to tiny jackhammers. For stable specimens, much of the extraction work is done using handheld pneumatic jackhammers capable of pulverizing rock to chip away at the stone bit by bit, revealing the fossil. For more delicate work on unstable fossils, or finishing touches made closer to the bone, preparators use needles, brushes, and sharp sculpting tools to remove the final vestiges of rock from a fossil.

6 TAKE A PICTURE (IT'LL LAST LONGER)

While most of the work is still done with traditional tools, new technology is slowly beginning to change the field. Computed tomography (CT) scans of fossils can provide scads of information about what's contained inside.

"Sometimes a scan can guide prep work, revealing the structure of the specimen within the matrix, making the process a little easier," says Ruth O'Leary, director of collections, archives, and preparation in the Division of Paleontology.

4 HIT THE BOOKS

Before any work is done to remove the fossil, Museum preparators hit the published literature to bone up on the specimen they're about to begin extracting, or similar related creatures if an identification hasn't been made.

Sculpting tools (inset) help fossil preparators like Ana Balcarcel (below) get fossils ready for researchers.



7 BACK UP YOUR WORK

Once a fossil is extracted, or as exposed as it can safely be, preparators often back up their hard work by making a silicon mold that can be used to create casts of the fossil. These casts, most often made from a polyester resin, are key to paleontological research. They make it easier to study the specimen without handling it.

Central Park West at 79th Street
New York, New York 10024-5192
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Cover illustrations by Zhao Chuang, courtesy of Peking Natural Science Organization



The feathered dinosaur *Khaan mckennai*, discovered in the Mongolian desert by a team of paleontologists including Mark Norell, Macaulay Curator and Chair of the Division of Paleontology, is one of the many intriguing species featured in the upcoming exhibition *Dinosaurs Among Us*. Members at the \$105 level and above are invited to view the exhibition before it opens to the public on March 21. See page 9 for details.

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, 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: **E** (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.