On December 10, 2014, the Museum’s Board of Trustees voted unanimously to create a new facility on the Museum’s west side, near Columbus Avenue at 79th Street. To be named the Richard Gilder Center for Science, Education, and Innovation after Trustee and longtime benefactor Richard Gilder, the new facility will meet many of the Museum’s programmatic and visitor needs in an era of scientific advancement, educational priorities, and burgeoning technology.

It has become increasingly apparent that the expression of the Museum’s mission in the 21st century calls for new kinds of facilities that are even more immersive, integrated, and technologically advanced. With the new Gilder Center, the Museum will sustain its longstanding leadership in science and education, particularly in the areas of cutting-edge research, STEM (science, technology, engineering, and mathematics) education, and enhancing science literacy among the general public. To do so, it will house some of the most thrilling and high-tech exhibits, theaters, laboratories, classrooms, teaching facilities, collections, and gathering spaces anywhere.

In addition, as those of you who have visited recently know, the Museum is nearly bursting at the seams, with yearly attendance having grown to approximately 5 million. Navigation and improved visitor services are continuing challenges that the new Gilder Center, which will connect to the existing facility, will help to address.

We hope to unveil the Gilder Center during the Museum’s 150th year, 2019–2020. In the meantime, I look forward to updating you as we proceed with the planning and design for this exciting new addition to the Museum campus.

The Museum’s Sackler Educational Laboratory is looking for a few good Neanderthal detectives—and you just might fit the bill.

Earlier this year, 19 high school seniors from Millennium Brooklyn High School wrapped up a 14-week program in which they worked with a science advisor and Museum staff to develop an interactive experience for family visitors based on cutting-edge research and rooted in the Spitzer Hall of Human Origins and the Sackler Educational Laboratory. Drawing on the latest findings about our relatives Homo neanderthalensis, it even has a ready-for-prime-time name: CSN: Crime Scene Neanderthal.

Family visitors who participate in CSN will be led by student interns, armed with a paper guide and a mobile app, to explore both virtual and cast Neanderthal fossils to solve a science-based mystery. It’s part of an experimental approach to engaging youth in science learning by challenging students to co-design a unique Museum experiences for families.

“CSN is both a fantastic opportunity for the students and a 21st-century learning experience for Museum visitors,” says Barry Joseph, the Museum’s associate director for digital learning. “CSN helps us explore what digital layers—like mobile games, augmented reality, access to real-time information, and more—can add to a young visitor’s engagement with scientific content within the Museum.”

In April and May, Members will have a chance to experience the program firsthand when the student developers return to the Museum to test the prototype with the public, guiding groups of families and youth to dioramas and microscopes to unravel such puzzles as: How do we know a Neanderthal’s hair color? What can clues tell us about Neanderthal culture? What killed off this recent human relative? (See the sidebar for details on how you can participate.)

“This interactive experience will add new content to the hall and show visitors that science is a dynamic process with new information emerging all the time,” says Julia Zichello, manager of the Sackler Educational Lab. “CSN more directly links the hall to the hands-on experience in the lab.”

Coming soon from another student digital learning project: MicroRangers, a mobile game to solve problems related to microbial organisms, biodiversity, and human health, that will launch this fall as the Museum opens a special exhibition on the human microbiome.

The Museum greatly 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.

The 14-week student program and spring internships are supported by a generous grant from The Peter and Carmen Lucia Buck Foundation.

Additional support for the development of the “CSN” prototype was provided by Miguel and Grace Hennessy and The Margarita and John Hennessy Family Foundation.
**Close-Up at the Museum**

**Tools in the Field**

In the quest for better prediction, volcanologists use satellites to spot telltale signs, such as bulges in a volcanic mountainside or rising temperatures registered in infrared wavelengths. Tilt meters also detect changes in slope, while seismometers track earthquake tremors as magma ascends and the tremors creep closer to the surface. Instruments on planes, trucks, or positioned by scientists on the edge of a crater measure gas content.

**Most Common Volcano**

There are many types of volcanoes, but the most common is the cinder cone, in which an explosive eruption of gas sends runny lava (runny because of low-silica content) flowing from a volcanic vent. The fragments cool, harden, and fall to the ground, accumulating around the vent in a cone shape. Most volcanoes of this type are small, around 1,000 feet in height or less.

**High Drama**

The most explosive and much larger volcanoes—stratovolcanoes—spew a massive column of gas and ash into the air or out the mountainside, sending incandescent debris, called pyroclastic flow, rushing downward at hundreds of miles an hour. Perhaps the most famous example is Italy’s Vesuvius, which buried Pompeii in AD 79. The Geyser Hall of Planet Earth features a large cast of a collapsed column from a villa excavated in Pompeii that reveals that fatal sequence of events.

**SLOW MOVER**

Shield volcanoes get their name from their shape, a gentle slope resembling an upside-down warrior’s shield, formed by lava as it cools. They can stretch for miles and erupt for years. Kilauea, the most active of the five volcanoes on the Island of Hawai‘i, is a shield volcano. This relatively flat volcano is often lauded for being benign tourist attraction made news around the world last year when its lava advanced into the town of Pāhoa, ignoring properties in its path.

**Uncertainty Principle**

Despite great strides in understanding and even predicting volcanoes, the unexpected still occurs, sometimes with tragic results. Last September in Japan, magma from much-monitored Mount Ontake came into contact with a crater lake, setting off a sudden explosion of hot gas and ash that killed more than 60 climbers near the top. Similarly, in the U.S., closely watched Mount St. Helens killed 57 people when it erupted in 1980 with record-breaking force.

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**Recipes for Eruption**

Early in their course work, some of the Earth science students in the Museum’s Master of Arts in Teaching program get an explosive lesson object in the petrology lab of geologist James Webster. They recreate a volcano.

“They are very excited to be able to do that,” says Dr. Webster, curator in the Department of Earth and Planetary Science, who notes that visitors can try their hand at erupting a virtual volcano in the special exhibition Nature’s Fury.

The way Webster’s experiment works is this: The students take a small chip of igneous rock, like the gray Augustine volcano pumice or the black basalt from Mt. Vesuvius, above. They tuck the sample, along with water, inside a tiny gold cylinder, which in turn is put into a 200-pound steel reaction vessel. (Why gold? Because it is one of the more chemically resistant metals and won’t interfere with chemical reactions within the vessel. It is also malleable, allowing pressure to affect the sample.) The gold cylinder is then subjected to extreme pressure and high heat—nearly 2,000° Fahrenheit—which causes the water and its constituent gases to “dissolve” into the molten rock sample. Finally, when the pressure is dropped, the gases come back out of the melt, they expand, and voilà! A tiny volcano.

The experiment is fun, but it’s also a vivid example of painstaking efforts being employed by Earth scientists to unlock the variables that make some volcanoes the destructive powerhouses they are.

Again and again, changing the kinds and amounts of added materials—water, sulfur, chlorine, carbon dioxide—and varying the heat and pressure, Webster and his colleagues calculate the effects of different combinations of gas, rock, heat, and pressure and their potential to create a major eruption. The type of rock is a factor, too. Basalt and pumice, for example, are at opposite ends of the viscosity spectrum. Basalt’s low-gas, low-silica, and low-viscosity makeup results in eruptions of slow-moving lava; pumice’s high-gas, high-silica content, and higher viscosity create more explosive outcomes.

“Ultimately we are trying to generate enough data to create models,” says Webster. “There are so many combinations, there’s no way to replicate all of nature. But models can tell us how certain materials under certain conditions will likely behave.”

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**A Shark’s Sense**

The flattened head of the hammerhead shark (family Sphyridae) is more than just a distinctive feature: it’s the anatomical structure behind these animals’ extraordinary sensory capabilities.

Hammerheads depend on some of the same senses as humans. Their broad, flat head, known as a cephalofoil, enhances several of these, including vision and smell. Wide-set eyes provide a better visual range, allowing the hammerhead to see above and below it on both sides, and the spacing of the far-apart nostrils helps the shark determine the direction from which a scent originates.

Maneuvering around a marine habitat, hammerheads have also developed ways to detect key signals, including vibrations, currents, and changes in water pressure. And when they hunt, they use their electroreactory ability to locate prey.

How? Even small muscle movements generate bio-electrical signals, which are amplified in an aquatic environment. A hammerhead can detect these impulses with sensory organs called ampullae of Lorenzini. The ampullae are composed of clusters of pores concentrated around the shark’s mouth and along its front that are lined with hair-like cells that send signals to the brain when stimulated. When searching for food, a hammerhead sweeps its head from side to side like a metal detector to pick up electrical signals. In this manner, sharks successfully root out rays—a favorite snack—and other bottom-dwelling fishes that bury themselves in sand or mud on the ocean floor.

The sharks’ electroreactory capability also helps them pick up on electrical fields generated by salt water as it moves through the Earth’s magnetic fields, allowing hammerheads to orient themselves during daily feeding and long-distance migrations. It’s even used in reproduction: during mating season, males can find females by tracking the bioelectric fields they produce.

Electrosensitivity is not unique to hammerheads; other sharks and rays also have these ampullae. But here the shape of the species’ head offers another advantage. The higher number and density of pores on the cephalofoil of the hammerhead are thought to give this family greatly electroreactory capabilities than those of its more streamlined cousins.

See a life-size hammerhead shark model over the entrance to the Milstein Hall of Ocean Life.

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**Sense and Sensitivity**

The electroreactory ampullae of Lorenzini were first discovered by Marcello Malpighi, an Italian biologist in Bologna, Italy, in the 1600s. In 1678, the Florentine physician Stefano Lorenzini won naming rights by describing the organs in detail, although he speculated that ampullae were mucus ducts. Over the next 300 years, until Dutch researchers finally determined their function, ampullae were believed at various times to sense touch, pressure, salinity, and temperature.

**A Distinctive Family**

The family Sphyridae includes 10 species of hammerhead worldwide, only three of which (the scalloped, great, and smooth) pose any danger to humans. The Carolina hammerhead (Sphyra plachyurus) is the most recently described species (2015). The great (Sphyra mokarran) and scalloped (Sphyra lewini) hammerheads are listed as endangered, and two other species as vulnerable, by the International Union for the Conservation of Nature. Overfishing due to high demand for their fins, which are considered a delicacy in some places, is a top threat.

**Group Efforts**

Before top populations crashed from overfishing, schools of hundreds of scalloped hammerheads were a common sight in the Gulf of California. Hammerheads are not the only sharks to engage in such mass aggregations—whale sharks, among other shark species, have been observed gathering in large numbers as well—but this behavior makes them particularly vulnerable to fisheries.

**Marine Marvels**

Find out more about how the ocean’s most unique organisms adapt and thrive at the family-friendly Milstein Science Series, which is free for Members. Upcoming programs include Incredible Oceans on Sunday, April 19, and Sea Turtles on Sunday, May 3. See pages 14 and 15 for more details.
Some species are so hardy, so creative in their responses to the usual wear, tear, and stress of life, they seem to cheat death. Here are just three of the remarkable organisms featured in the Museum’s new exhibition Life at the Limits: Stories of Amazing Species.

**FEAT 1: PLAY DEAD**

Tardigrades—a group of microscopic eight-legged animals that resemble plump piglets in puffier coats—have been charming and astonishing biologists in equal measure since they were first discovered in the 1770s. Zoologist Johann Goeze first dubbed the tiny aquatic animal he saw lumbering around on clawed legs “kleiner Wasserbär”—German for little water bear. A few years later, Italian naturalist Lazzarro Spallanzini named them slow steppers (*tardigrada*)—and provided the first description of the amazing transformation tardigrades undergo when under environmental stress. (More on that in a bit.)

Tardigrades are phenomenally successful organisms, having first appeared more than half a billion years ago. More than 1,000 species can be found all over the world, in sea and fresh water as well as on land, where they cling to moist mosses or lichens. But though they’re common in moderate climes, terrestrial tardigrades are also among the few animals that thrive in spots that are particularly inhospitable to life, such as Antarctica’s McMurdo Valleys, thought to be the driest and coldest desert on Earth.

To eke out a living in the mosses of Antarctica and even in more mild places where their habitats are vulnerable to sudden water loss, tardigrades have evolved a remarkable ability. When conditions turn life-threatening—whether from rapid drying, extremes in temperature, or spikes in salinity—they seem to defy death by imitating it. Tardigrades temporarily wind down their metabolism in a reversible process called cryptobiosis, literally, hidden life.

There’s still much to be learned about the mechanisms by which tardigrades become cryptobiotic when faced with different stressors. The dramatic change they undergo in response to lack of water—anhydrobiosis, first described by Spallanzini in 1776—is still the best understood. First, the animal curls into itself, tucking its eight limbs and head inside its body. It sheds more than 95 percent of its water, shriveling into a blob, one-third its original size, known as a tun for its resemblance to a beer barrel. In the process, the tardigrade produces a sugar that replaces the lost water, protecting internal structures from fatal damage. Metabolic processes dwindle to less than 0.01 percent of normal activity as the tardigrade waits for conditions to improve.

As tuns, tardigrades appear to be lifeless, and indestructible. Researchers have exposed tuns to extreme temperatures on either side of the scale, including 20 hours at absolute zero, to extreme pressures, and to toxic concentrations of gases such as carbon monoxide. In all cases, tardigrades have amazingly sprung back to life once water was resupplied. In 2007, the European Space Agency even tested tuns in space, sending two species of tardigrades into low Earth orbit on the FOTON-M3 mission. The tuns didn’t disappoint: *Milnesium tardigradum*, the ultra-resilient tardigrade species that can endure open space? Just 56 days after hatching.

**FEAT 2: PLAY DEAD**

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**FEAT 3: PLAY DEAD**

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While the tardigrades' extraordinary resilience is a response to rapidly changing conditions, other species have risen to a different sort of challenge: enduring a consistently severe environment.

How severe? Consider the Southern Ocean, which surrounds Antarctica. The highest temperatures in the waters near Antarctica's northernmost peninsula reach 1.5°C (45.7°Fahrenheit) and that only during the brief summer months.

The saving grace of this chronic chill is its unrelenting consistency. With less than a 4°C difference between its highs and lows, the Southern Ocean is considered to be the most thermally stable marine environment on the planet—and one of the most long-lived. This narrow range of temperatures has been a feature here for the last 10-14 million years. Furthermore, currents and deep ocean trenches around Antarctica conspire to keep warmer waters away, isolating the Southern Ocean in the extreme. This has allowed a group of particularly gritty animals to stake their claim on a singularly severe sea: about 90 percent of the fishes in the Southern Ocean belong to a single suborder, Notothenioidei.

To survive in an environment where water temperatures drop below the freezing point of water, notothenioids have evolved incredible characteristics. Many species produce antifreeze proteins that thwart ice crystals from forming, in their bodies during a big chill. But the species that belong to the family Channichthyidae, which branched off from the order Beryciformes, have taken their unique adaptation to another level. They became the only vertebrates without red blood cells and hemoglobin—an oddity that manifests itself in their eerily colorless blood.

The medusae of Turritopsis dohrnii have an extraordinary survival skill. In response to physical damage or even starvation, they can transform back into a polyp. The born-again polyp colony eventually buds and releases medusae that are genetically identical to the injured adult. It's a process that looks remarkably like immortality. In fact, since this phenomenon was first observed in the 1990s, Turritopsis dohrnii has come to be called the "immortal jellyfish." The cellular mechanism behind this rare process known as transdifferentiation—is of particular interest to scientists for its potential applications in medicine. By undergoing transdifferentiation, an adult cell, that one is specialized for a particular tissue, can become an entirely different type of specialized cell. It's an efficient way of cell recycling and an important area of study in stem cell research. If stem cells have this capacity, and if we can learn to harness it, transdifferentiation could be used to replace cells lost to or damaged by disease.

As for Turritopsis dohrnii, this jelly is not only an extraordinary survivor. It's also an increasingly aggressive invader. Marine species have long been known to hitch rides around the world in the ballasts of ships, which take on water in originating ports for ballast and then release it, along with any stowaways, at the final destination. Researchers have recently identified Turritopsis dohrnii as an "excellent hitchhiker," particularly well-suited to surviving long trips on cargo ships. In the same study, researchers also documented essentially genetically identical Turritopsis dohrnii individuals distributed across the world's oceans. If all of an organism's cells are replaced, is it still the same individual? The genes are the same, course—and in biology, that may be enough to declare a winner.

Explore other amazing organisms in Life at the Limits: Stories of Amazing Species, now open and free for Members.
**MARK SIDDALL**

Mark Siddall took a surprising turn away from medical school when, while researching blood parasites in college, he found himself more interested in the delivery system—leeches—than in the bodies they invaded.

His passion for these bloodsuckers and protozoan parasitology in general has taken him from the Amazon to Africa. In addition to his role as curator in the Division of Invertebrate Zoology, Dr. Siddall enjoys a reputation as an “expeditionary gastronomist”—game to try live grubs, sea urchin gonads, and seaweed custard in the field.

Dr. Siddall is currently studying *Ozobranchus*, a group of leeches that feeds on the blood of turtles. *Ozobranchus margot* targets green sea turtles (*Chelonia mydas*) and *Ozobranchus branchiatus* are found in a variety of sea turtles, primarily loggerheads (*Caretta caretta*). Like other blood-feeding leeches, these parasites open a wound and deliver an anticoagulant to prevent blood clotting, attaching themselves on the mouth, neck, cloaca, and flippers of turtles. An Asian species, *Ozobranchus jantseanus*, is highlighted in the exhibition for its ability to survive a 24-hour dunk in liquid nitrogen.

Siddall’s favorite invertebrate in the exhibition? The flying fish (family Exocoetidae) found in tropical and subtropical areas of the Pacific, Atlantic, and Indian oceans. Flying fish have large pectoral fins—and in some species, enlarged pelvic fins as well—that act as “wings,” allowing them to leap up and glide above the water. “I’ve seen them in the wild in Raja Ampat, Indonesia,” says Siddall. “They were streaking across the water behind our boat. Wicked fast!”

**JOHN SPARKS**

Sparks was fascinated by electric fishes, especially the African mormyrids (elephantfishes) and South American gymnotiformes (knifefishes). In the deep, dark turbid waters where these species live, vision is of little use. Both groups have independently evolved similar systems of communication via electric signals: gymnotiforms signal to mates, and mormyrids pack hunt. “Even as a kid I was amazed by electric fishes,” says Sparks. “But when I learned that some groups have evolved unique species-specific systems of communication based entirely on electric wave and pulse signals, I was blown away.”

Sparks was born to be an ichthyologist. He loved fish since boyhood, nurturing cichlids in a home aquarium. And he was certified as a scuba diver at the very first opportunity—at age 16, in an Ohio quarry, on a snowy day in March.

As curator-in-charge in the Museum’s Department of Ichthyology, Dr. Sparks has studied freshwater fishes in Madagascar, blind cavefishes, and, more recently, a variety of bioluminescent and biofluorescent fishes, work that has taken him to the Indo-Pacific region, South America, the Western Atlantic, and the Caribbean.

An accidental discovery on a 2011 trip to the Cayman Islands led Sparks to his recent focus on biofluorescent fishes. One photo of a coral reef showed a bright green eel none of the team had seen while in the water. It turned out to be a false moray eel that exhibited biofluorescence—the capacity to absorb light, transform it, and eject it in a different color—a phenomenon virtually unknown until then in fishes. Sparks and his team went on to discover that molecules in many fishes absorb ambient blue light, “left over after most of the remaining visible light spectrum has been absorbed in shallow water, and re-emit it in neon greens, reds, and oranges. “Well-camouflaged fishes you would never notice otherwise under white light exhibit extremely brilliant and vivid fluorescent patterns,” says Sparks.

As for a favorite species from the exhibition? “There are so many to choose from, but I would have to say the treehoppers,” says Sparks, calling out a harmless, plant-eating insect (*Cyphonia clavata*) with a structure on its back that resembles a venomous turtle ant (*Cephalotes atratus*). The treehopper is among the many different species that mimic ants. Ants can be venomous, have a painful sting, or an acrid taste—any of which might scare off a predator. This species has never been observed using the “ant” as protection, so its purpose in this case is conjecture, says Sparks.

The treehopper, (*Cyphonia clavata*), is highlighted in the exhibition? “There are so many to choose from,” says Sparks. “But when I learned that some groups have evolved unique species-specific systems of communication based entirely on electric wave and pulse signals, I was blown away.”

**CURATORS’ PICKS**

1. **PARASITE WORM**

As a child, Mark Siddall was inspired by the film *Jaws* and his fascination with the animal kingdom. In his career, he has helped to unravel the secrets of parasitic worms, focusing on Ascaris lumbricoides, the most common parasitic worm known to humans.

2. **ELECTRIC FISHES**

John Sparks was fascinated by electric fishes, especially the African mormyrids (elephantfishes) and South American gymnotiformes (knifefishes). In the deep, dark turbid waters where these species live, vision is of little use. Both groups have independently evolved similar systems of communication via electric signals: gymnotiforms signal to mates, and mormyrids pack hunt.

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**LIFE AT THE LIMITS OPENS APRIL 4**

**Stories of Amazing Species** highlight three species that have ignited their interest throughout their careers—including a favorite from the new exhibition.

Curators of *Life at the Limits: Stories of Amazing Species* ignite their interest throughout their careers—including a favorite from the new exhibition. **111110 111111**
The Imitators

An exceptional mimic finds a fan

In nature, imitation is not just the sincerest form of flattery—it’s often the best defense. By taking on the characteristics of a more threatening, often venomous species, an animal can fool predators into staying away. In 1998, researchers discovered a particularly gifted impersonator: Thaumoctopus mimicus. This 2-foot-long octopus species has been observed parroting not one but several toxic species—the first animal of any group known to shift between multiple imitations, a talent called dynamic mimicry.

Depending on which predator is lurking around, the mimic octopus adjusts its posture by folding, splaying, or hiding its arms to copy the shape, texture, and motions of the banded sole, lionfish, or banded sea snake—three toxic animals that share dark-light coloring and striped patterns. Scientists have observed other behaviors that suggest these cephalopods have an even bigger repertoire, mimicking anemones and jellyfish when it suits them.

In another twist, in 2011 researchers discovered that the mimic octopus has its own mimic—the harlequin jawfish (Stalix histrio), which sticks close to the octopus to avoid detection while swimming outside of its burrow.

See more amazing organisms in Life at the Limits: Stories of Amazing Species, which is free for Members.
**Exhibitions**

*Admission is by timed entry only.*

**Life at the Limits: Stories of Amazing Species**

**Free for Members**

Discover the diverse and sometimes jaw-dropping strategies animals and plants employ to find food, fend off predators, reproduce, and thrive in habitats we would find inhospitable, even lethal.

**Nature’s Fury: The Science of Natural Disasters**

**Free for Members**

From earthquakes and volcanoes to tornadoes and hurricanes, nature’s forces shape our dynamic planet and endanger people around the world. Discover the causes of these natural yet hazardous events and explore the risks associated with each.

**Countdown to Zero: Defeating Disease**

**Free for Members**

This exhibition developed in collaboration with The Carter Center highlights scientific and social innovations that are working to defeat some of the world’s most deadly diseases—including the 30-year campaign that may soon eradicate Guinea worm disease.

**Natural Histories: 400 Years of Scientific Illustrations**

**Free for Members**

Featuring scientific illustrations spanning five centuries, this visually striking exhibition explores the integral role illustration has played in scientific discovery.

**The Butterfly Conservatory**

**Closes Monday, May 25**

Please check amnh.org for Member prices.

**Rotunda / Spring 2015 / AMNH.org**

**Programs and Events**

**April**

**SciCafe: Why Walk on Two Legs?**

**Wednesday, April 1 Free for 21+ with ID**

Join Museum Curator Brian Richmond and Jeremy DeSiva from Boston University in exploring the advantages of walking on two legs, as well as the unfortunate consequences of evolving bipedalism from a body plan designed to walk on four legs.

**Colonel Louis Cook:**

**Revolutionary War Hero**

**Tuesday, April 14 6:15 pm Free; reservations required**

Join Curator Peter Whiteley for an exploration of the life of Col. Louis Cook, Maytag/hot tub inventor and Native American officer in the Continental Army during the Revolutionary War.

**Culture Salon:**

**Rice Wine and Sake**

**Thursday, April 16 6:30 pm–7:30 pm $45**

Shup Doelman describes an effort to link radio dishes around the world to form an Earth-sized virtual telescope that could make the first images of the supermassive black hole at the center of the Milky Way.

**Super Science Lab: Sea to Space**

**Saturday, April 18 9 am–4 pm $18**

Life on Earth is—as far as we know—unique in the universe. In this daylong workshop, complete with tasting menu, we will apply what we know about the extreme ecosystems of the deep ocean to what astronomers are uncovering in deep space.

**Milletstein Science Series: Incredible Oceans**

**Sunday, April 19 11 am–4:30 pm Free**

In conjunction with the Museum’s Life at the Limits exhibition, this program will examine the life cycles and adaptability of the oceans’ most unusual creatures. Join us for live performances, live animals, and presentations from scientists.

**Spring Blooms Trolley Tour**

**Saturday, April 25 10:30 am–12:30 pm $25**

Green-Wood Cemetery is one of the most beautiful historical sites in New York City. Prepare to be dazzled by the spring blooms at Green-Wood Cemetery on a private trolley tour with Joe Charap, curator of the plant collection.

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**Astronomy Live:**

**How Big Is the Universe?**

**Saturday, April 25 6:30 pm $15**

Look up into the night sky—can you tell how big the universe is? Brian Levine explores the history of human perception of the breadth of the universe.

**Baby Animal Encounter**

**Saturday, April 25 11 am (recommended for younger children), 1 pm, 3:30 pm $10**

Meet some of nature’s wildest and cutest youngsters, with animal expert Jarod Miller.

**Behind the Scenes:**

**Herpetology**

**Tuesday, April 21 6:30 pm–7:30 pm Enter at 77th Street $25**

Curatorial Associate David Kizirian shares research from fieldwork in Vietnam while Scientific Assistant Lauren Vonnahme discusses sea turtle research. The tour is for visitors ages 10 and up.

**Milstein Science Series: Defeating Disease**

**Monday, April 27 6:30 pm $15 per session ($45 series)**

Probe the science behind brain-based illnesses such as autism, ADHD, depression, and addiction in this salon-style series led by experts.

**Super Science Lab: Sea to Space**

**Saturday, April 18 9 am–4 pm $18**

Life on Earth is—as far as we know—unique in the universe. In this daylong workshop, complete with tasting menu, we will apply what we know about the extreme ecosystems of the deep ocean to what astronomers are uncovering in deep space.

**Milletstein Science Series: Incredible Oceans**

**Sunday, April 19 11 am–4:30 pm Free**

In conjunction with the Museum’s Life at the Limits exhibition, this program will examine the life cycles and adaptability of the oceans’ most unusual creatures. Join us for live performances, live animals, and presentations from scientists.

**Spring Blooms Trolley Tour**

**Saturday, April 25 10:30 am–12:30 pm $25**

Green-Wood Cemetery is one of the most beautiful historical sites in New York City. Prepare to be dazzled by the spring blooms at Green-Wood Cemetery on a private trolley tour with Joe Charap, curator of the plant collection.

**Astronomy Live:**

**How Big Is the Universe?**

**Saturday, April 25 6:30 pm $15**

Look up into the night sky—can you tell how big the universe is? Brian Levine explores the history of human perception of the breadth of the universe.

**Baby Animal Encounter**

**Saturday, April 25 11 am (recommended for younger children), 1 pm, 3:30 pm $10**

Meet some of nature’s wildest and cutest youngsters, with animal expert Jarod Miller.

**Behind the Scenes:**

**Herpetology**

**Tuesday, April 21 6:30 pm–7:30 pm Enter at 77th Street $25**

Curatorial Associate David Kizirian shares research from fieldwork in Vietnam while Scientific Assistant Lauren Vonnahme discusses sea turtle research. The tour is for visitors ages 10 and up.

**Milstein Science Series: Defeating Disease**

**Monday, April 27 6:30 pm $15 per session ($45 series)**

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SciCafe: Cone Snails and Venom

Saturday, May 6
7 pm
Free for 21+ with ID

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

Member House Tour: Mothers and Babies in the Wild
Saturday, May 9
10:30–noon
Free for Members

Learn about the unique ways that mothers in the wild interact with their babies, and the lengths they go to in order to care for their offspring and protect them. This special tour will explore the Axley Hall of African Mammals and the bird and dinosaur halls.

SciCafe: Finding so-called Goldilocks Planets

Tuesday, May 12
6–8 pm
Free for Adventure-level Members and above

Join us for a special presentation about our latest exhibition Life at the Limits: Stories of Amazing Species with Curator Mark Siddall. Following the lecture, enjoy an after-hours visit and explore the exhibition free of crowds.

Foundations

Birding in Prospect Park
Saturday, May 16
10 am–1 pm
$15

Join Museum ornithologist Paul Sweet to look, for birds on their spring migration as they pass through Brooklyn’s Prospect Park.

Humans as Animals: Primate Politics, Culture, and Morality
Thursday, May 21
6:30 pm
$15

Find out how the two brightest planets, Venus and Jupiter, slowly approach each other in the southern sky under the “Lord of the Rings,” Saturn, displaying the best views of its rings in at least 10 years.

SciCafe: Flipping Over Darwin

Wednesday, June 3
8 am–pm
$95

Join us for a special presentation about our latest exhibition Life at the Limits: Stories of Amazing Species with Curator Mark Siddall. Following the lecture, enjoy an after-hours visit and explore the exhibition free of crowds.

Great Swamp Refuge, Moorestown, New Jersey, consists of 7,600 acres of varied habitats. It’s a resting and feeding area for more than 244 species of birds and a variety of reptiles and amphibians, wildflowers, and plants. Join ornithologist Paul Sweet and herpetologist David Kizirian for a day trip. Round trip transportation by private coach is provided from the Museum.

Astronomy Live

Dance of the Planets
Tuesday, May 26
6:30 pm–7:30 pm
$15

Using our Zeiss IX Planetarium projector, Joe Rao will demonstrate how the two brightest planets, Venus and Jupiter, slowly approach each other in the southern sky under the “Lord of the Rings,” Saturn, displaying the best views of its rings in at least 10 years.

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

Nature’s Fury: The Science of Natural Disasters was originally created by The Field Museum, Chicago, with additional content developed by the American Museum of Natural History.

Nature’s Fury is proudly supported by Travelers.

The presentation of Natural Histories at the American Museum of Natural History is made possible through the generosity of the Arthur Ross Foundation.

Countdown to Zero is proudly supported by Conrad N. Hilton Foundation, Ioni clubs International Foundation, Meitzan Donation Program, Mr. John J. Moores, Sr., and Vestergaard.

This exhibition is made possible through the generous sponsorship of Accenture.

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 Con Edison.

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Countdown to Zero is proudly supported by Con Edison.
Astronomy Live: Southern Skies
Tuesday, June 30
6:30 pm
$10
The sky of the Southern Hemisphere may be unfamiliar, but it is actually home to many of the brightest stars, the closest star to Earth, the Magellanic Clouds, the Southern Cross, and much more! Join Hayden astronomers Christina Pease and Lydia Maria Petsinou as they highlight some of these gems.

Whale Watching Adventure
Saturday, June 27
10 am–6:30 pm
$95
New York City waters are abundant in wildlife and marine animal activity, including migrating whales. Enjoy a ferry ride from Pier 11 to Far Rockaway, Queens, where you’ll join naturalists Paul Siesweda and Kristi Collum on a private boat tour around New York Harbor. Learn about research on dolphin acoustics and why whale migration patterns are changing, and perhaps spot a few of these gentle giants along the way! (Sailing whales is likely, but not guaranteed.)

Fun with Fossils
with Carl Mehling
Saturday, June 27
9 am–5 pm
$55
Pack your collecting bag, old sneakers, and lunch, and travel back in time with a Museum fossils expert for an expedition to Big Brook in Monmouth County, New Jersey. The area offers a variety of invertebrate and vertebrate fossils from the Late Cretaceous period. Feel free to bring your own collecting equipment.

July
Journey to a Lost World
with Paul Nascimbene
Saturday, July 25
9 am–4 pm
$55
Pack your collecting bag, old sneakers, and lunch, and travel back in time with a Museum fossils expert for an expedition to Big Brook in Monmouth County, New Jersey. The area offers a variety of invertebrate and vertebrate fossils from the Late Cretaceous period. Feel free to bring your own collecting equipment.

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.

The late Dr. Isaac Asimov, one of the most prolific and influential authors of our time, was a dear friend and supporter of the American Museum of Natural History. In his memory, the Hayden Planetarium is honored to host the annual Isaac Asimov Memorial Debate—generously endowed by relatives, friends, and admirers of Isaac. Asimov and his work—hinging the minds in the world to the Museum each year to debate pressing questions on the frontier of scientific discovery. Proceeds from ticket sales of the Isaac Asimov Memorial Debates benefit the scientific and educational programs of the Hayden Planetarium.

Support for Hayden Planetarium Programs is provided by the Horace W. Goldsmith Endowment Fund.

Credits:
The April SciCafe event is presented in collaboration with The Leakey Foundation.
The May SciCafe event is supported by the Science Education Partnership Award (SEPA) program of the National Institutes of Health (NIH).
The SciCafe series is proudly sponsored by Judy and Josh Hirston.

Our Earth’s Future courses were made possible in part by the Institute of Museum and Library Services under grant number M44013-0200-33.

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

Support for Celebrate Culture Programs is provided, in part, by the May and Samuel Rudin Family Foundation, the Sidney, Milton and Lorna Simon Foundation, and The Max and Victoria Dreyfus Foundation.

Spotlight Asia is made possible in part by the New York State Council on the Arts with the support of Governor Andrew Cuomo and the New York State Legislature. Special thanks in the Ford Foundation.

NIGHTS AT THE MUSEUM
Join Hayden astronomers Christina Pease and Lydia Maria Petsinou as they highlight some of these gems.

APRIL
1
WEDNESDAY
SciCafe: Why Walk on Two Legs?
After-Hours Program
11
SATURDAY
Our Earth’s Future One-Day Course
Adult Course
16
THURSDAY
Rice Wine and Sake Celebrate Culture
18
SATURDAY
Super Science Lab: Sea to Space Adult Course
19
SUNDAY
Milstein Science Series: Incredible Oceans Family Program
21
THURSDAY
Behind the Scenes: Herpetology Member Program
25
SATURDAY
Spring Blooms Trolley Tour Member Program
28
TUESDAY
Isaac Asimov Memorial Debate: Water, Water Special Event

MAY
3
SUNDAY
Concrete Jungle: New York City and Our Last Best Hope for a Sustainable Future Member Program
Milstein Science Series: Sea Turtles Family Program
6
WEDNESDAY
SciCafe: Cone Snails and Venom After-Hours Program
9
SATURDAY
Identification Day Family Program
Member Hall Tour: Mothers and Babies in the Wild Member Program
11
MONDAY
A Planet for Goldilocks Hayden Planetarium Program
12
TUESDAY
Curator Lecture: Life at the Limits Member Program
14
TUESDAY
Colonel Louis Cook: Revolutionary War Hero Museum Lecture
16
SATURDAY
Bidding in Prospect Park Member Excursion
20
WEDNESDAY
Behind the Scenes: Earth and Planetary Sciences Member Program
21
THURSDAY
Humans as Animals: Primate Politics, Culture, and Morality Museum Lecture
23
SATURDAY
Spotlight Asia Celebrate Culture
26
TUESDAY
Dance of the Planets Hayden Planetarium Program
31
SUNDAY
Great Swamp Member Excursion

JUNE
2
TUESDAY
Behind the Scenes: Darwin Manuscripts Member Program
3
WEDNESDAY
SciCafe: Flipping the Genetic Switch After-Hours Program
4
THURSDAY
RoofTop Farming Member Excursion
8
MONDAY
Water World: Immersive Dome Experience Through Saturday, July 11
13
SATURDAY
Birding and Wine in the Basha Kill Member Excursion
17
WEDNESDAY
Evening Nature Walk with Julie Feinstein Member Excursion
20
SATURDAY
Whale Watching Adventure Member Excursion
27
SATURDAY
Fun with Fossils Member Excursion
30
TUESDAY
Southern Skies
Behind the Scenes in Collections

Collections are the lifeblood of scientific research, an irreplaceable record of biodiversity that can help answer—and inspire—questions not just today but for many years to come. So how do museums assure that biological specimens are preserved for future research? Let us count the ways...

Grab some DNA
Taking a DNA sample can be non-invasive, and it’s now standard procedure for biological specimens. A small sample of tissue—for instance, a fin clipping from a fish—can provide a treasure trove of information about the animal. Genetic material extracted from those samples is sequenced and analyzed by powerful computers and can be compared to other DNA samples, providing insight on how closely related two species are, among other things.

Fix it in Formalin
To stop tissue decay, specimens are treated in a bath of formalin, a solution of formaldehyde, for several days. Once a specimen becomes rigid, it’s rinsed and transferred for long-term storage in 70 percent ethyl alcohol. “We have specimens that are hundreds of years old, and they’re absolutely fine,” says Axelrod Research Curator Melanie L. J. Stiassny. The downside? Pigments dissolve, leaving specimens largely colorless.

Clean the Skeleton
Skeletal specimens are picked clean by the larvae of Dermestes maculatus, or hide beetles. After a sample’s skin and large organs are removed, these hungry insects go to work, stripping the dried flesh from small animals in a matter of days. “Hide beetles will gladly tackle any animal with little to no preference,” says Robert Pascocello, senior scientific assistant and keeper of the Museum’s in-house colony. If necessary, they can even make a meal of animals that have been previously preserved in ethanol.

Slice into Sections
Preserving a specimen doesn’t always mean keeping it intact. Sometimes it’s helpful for scientists to be able to examine the cellular structure of a creature. To provide this view, specimens are embedded in wax or epoxy and sectioned: cut into very thin slices using a microtome, a device that is essentially a very precise version of the deli meat slicer. These thin slices can then be stained with dyes that highlight different cell types and viewed through a microscope to observe fine cellular structures.

Clear, then Stain
Some fish, reptiles, and amphibians are treated with enzymes to turn them transparent, then with chemicals that dye their bones and cartilage vivid shades of red and blue, a process known as clearing and staining. The finished product is stored in glycerol. “Clearing and staining allows us to see the bones and cartilages of vertebrates in their natural positions and their relationships to soft body parts,” says Curatorial Associate David Kizirian.

Take a CT Scan
To see inside a specimen without destroying it, researchers can use non-destructive computed tomography, or CT scanning. A modern technique for gleaninng additional information about the specimens in the Museum’s collections, CT scans are an especially important method when the sample is particularly rare or delicate. CT scanning is now much more widely used in Museum research thanks to an in-house machine.

Grab some DNA

Fix it in Formalin

Clean the Skeleton

Slice into Sections

Clear, then Stain

Take a CT Scan

For a detailed look inside the Museum’s collections, catch up on the first four episodes of Shelf Life, a new original series at amnh.org/shelflife.

Episode 1: 33 Million Things
What’s in that jar? The Museum’s collections recently passed the 33-million mark. Our scientists and collections staff offer a glimpse of the treasures in the stacks.

Episode 2: Turtles and Taxonomy
Herpetologist Darrel Frost talks taxonomy, the science of classification, and how collections can inspire new questions.

Episode 3: Six Ways to Prepare a Coelacanth
Watch specimen prep methods and learn the story behind the Museum’s iconic prehistoric fish specimen, the coelacanth.

Episode 4: Skull of the Olinguito
Discover how one specimen—Mammal #66753—went from obscurity to scientific treasure nine decades after it was first collected.
Inside View

A few months ago, the Museum invited a few of the most popular photographers on Instagram, the photo-and video-sharing social network, to walk the halls after hours and tour a few behind-the-scenes collection areas.

The collaboration, #InsideAMNH, became an instant sensation. Rotunda picked some of our favorite shots to share with you—and to inspire you to share your photos with us.

SEND US YOUR PICS from your visits to the Museum—behind-the-scenes, or in your favorite gallery—by May 1, and we’ll highlight a few in our Summer issue. Email us your pictures, along with your name and your Membership number, to rotunda@amnh.org.

1. The Hall of Reptiles and Amphibians, photographed by @jmsuarez
2. @samthecobra photographed a cleared-and-stained specimen.
3. @jnsilva photographed beautiful morpho butterfly specimens.
4. Jamie Newman, senior scientific assistant in the Department of Earth and Planetary Sciences, was photographed with a specimen by @karimmustafa.
5. A glance at collections storage in this photo by @davekrugman.
6. This case in the Morgan Memorial Hall of Gems was photographed by @karimmustafa.
7. A close look at a specimen by @samthecobra.
8. Tyrannosaurus rex towers in this shot by @karimmustafa.
9. The Dolphin and Tuna diorama in the Milstein Hall of Ocean Life, photographed by @jmsuarez.
10. The Rotunda by @davekrugman
12. @davekrugman photographed these collections catalogs in the Department of Earth and Planetary Sciences.
13. The Hayden Sphere bathed in light in the Rose Center for Earth and Space, was photographed by @samthecobra.
14. The Guggenheim Hall of Minerals, and an onlooker, photographed by @samthecobra.
15. A drawer of sea urchins, captured by @jmsuarez.
**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, Life at the Limits Shop, Nature’s Fury 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.

*Life at the Limits: Stories of Amazing Species* explores the diverse and sometimes jaw-dropping strategies animals and plants use to find food, fend off predators, reproduce, and thrive in habitats most species would find inhospitable, even lethal.

The animal pictured above, the microscopic tardigrade, is one of the hardiest organisms on our planet. Find out more in this issue and by visiting *Life at the Limits*, which is free for Members.