

 AMERICAN MUSEUM OF NATURAL HISTORY

# ROTUNDA

Member Magazine  
Spring 2015 Vol. 40 No. 2



**LIFE AT  
THE LIMITS:**  
Stories of  
Amazing Species

**OPENS APRIL 4**



# From the President

Ellen V. Futter



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 long-standing 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.

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## ROTUNDA

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# Solve a Science-Based Mystery Designed by Teens



Hunting tool or murder weapon? High school students Monica Chhay and Sarah Carrillo show a visitor how to use a smartphone to create virtual Neanderthal tools.

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.

## Sackler Educational Laboratory

The Museum's Sackler Educational Laboratory for Comparative Genomics and Human Origins is a state-of-the-art interactive lab.

To help test "CSN: Crime Scene Neanderthal," join Museum staff and seniors from Millennium Brooklyn High School in the Sackler Educational Lab on **Saturdays and Sundays, from April 11 to June 6**. Come ready to pursue prehistoric clues!

The Sackler Educational Lab is located on the first floor, inside the Spitzer Hall of Human Origins. It is free for Members and open on Saturdays and Sundays from noon to 5 pm.

*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.*

© AMNH/M. Shanley



**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) flying 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 Gottesman Hall of Planet Earth features a large cast of a collapsed column from a villa excavated in Pompeii that reveals that fateful 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 benign tourist attraction made news around the world last year when its lava advanced into the town of Pāhoā, igniting 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.



Left: Pumice, catalog no. 5584  
Right: Basalt, catalog no. 1703

## 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 object lesson in the petrology lab of geologist James Webster. They recreate a volcano.

“They are very excited to be able to 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 then is 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 voila! 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.”

Design and erupt a volcano in an interactive feature of *Nature’s Fury: The Science of Natural Disasters*, which is free for Members.

Photos © AMNH/D. Firmin

## A Shark’s Sense

The flattened head of the hammerhead shark (family Sphyrnidae) 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 electrosensory 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’ electrosensory 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 greater electrosensory 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.



*Sphyrna lewini*

Photo © istockphoto.com/D. Burns

**SENSE AND SENSIBILITY**

The electrosensory ampullae of Lorenzini were first discovered by Marcello Malpighi, an Italian biologist in Bologna, Italy, in the 1660s. 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**

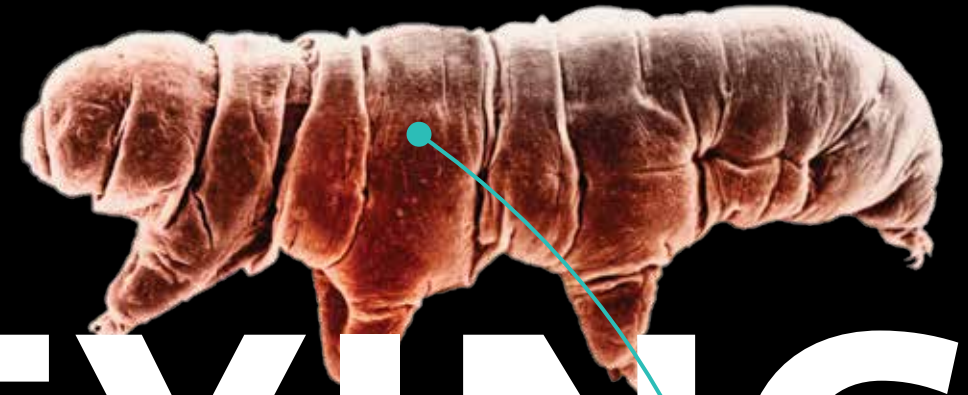
The family Sphyrnidae includes 10 species of hammerheads worldwide, only three of which (the scalloped, great, and smooth) pose any danger to humans. The Carolina hammerhead (*Sphyrna gilberti*) is the most recently described species (2013). The great (*Sphyrna mokarran*) and scalloped (*Sphyrna lewini*) 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 their 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.



# DEATH-DEFYING FEATS

## Three organisms that just won't quit

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 puffer 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 (*tardi grada*)—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 climates, 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 gasses 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

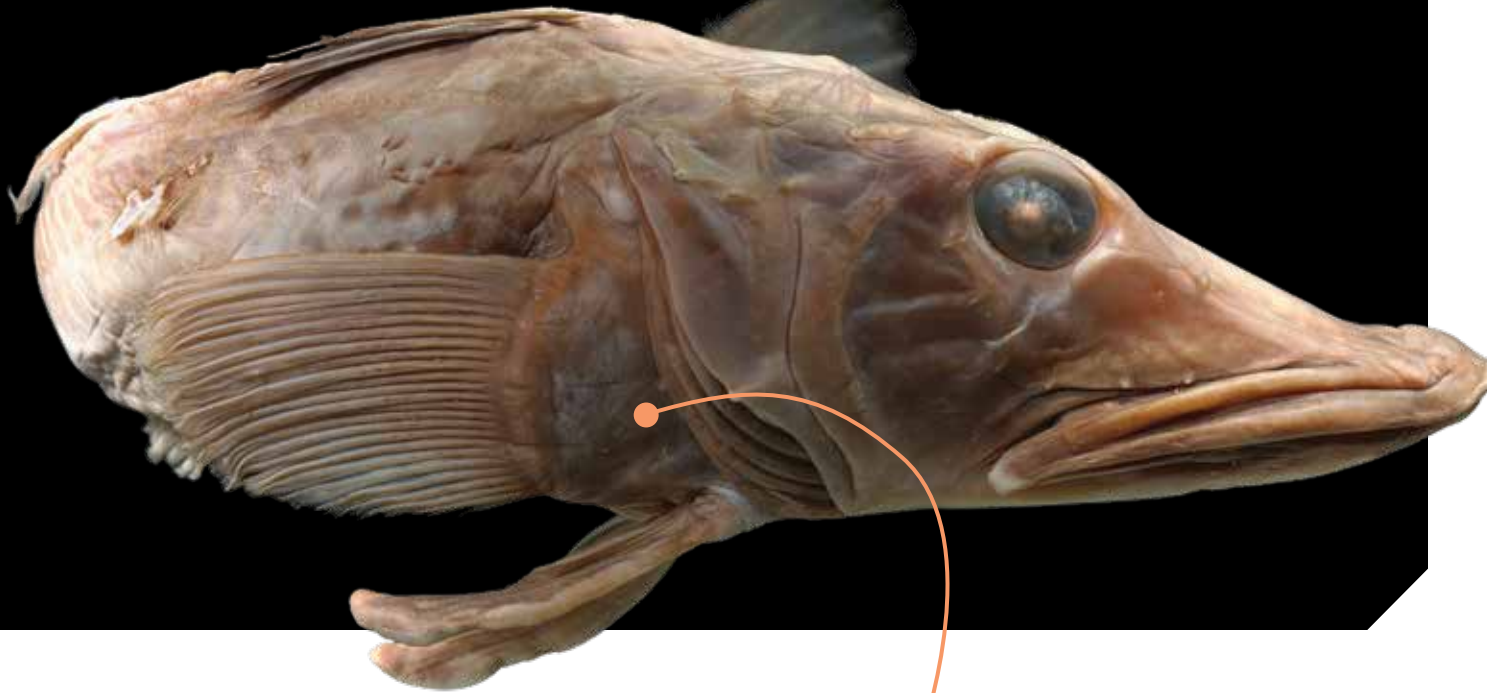
mission. The tuns didn't disappoint: **TARDIGRADES** became the first animals to survive the one-two punch of solar radiation and the vacuum of space.

Tardigrades are far from the only animals that enter cryptobiotic states—rotifers, nematodes, and other invertebrates do it as well. But, in part because it's so extraordinary, the tardigrade's hardiness has, at times, inspired some tall tales, including legends about their longevity. The total lifespan of tardigrades—that includes pauses to wait out unfavorable conditions—is actually thought to be under a decade.

And while phenomenal, the tardigrade's resiliency is not absolute: though the majority of tardigrades in the 2007 experiment survived simultaneous exposure to space vacuum and solar radiation, 52 percent didn't. Most humbling, perhaps: The longest verified uninterrupted lifespan of *Milnesium tardigradum*, the ultra-resilient tardigrade species that can endure open space? Just 58 days after hatching.

Photos: Oxford Scientific/Photolibary/Getty Images © David Spears FRP5 FRM5/Corbis, © Diane Nelson/Visuals Unlimited/Corbis





## FEAT 2: BE CLEAR (CLEAR-BLOODED, THAT IS)

While the tardigrades' extraordinary resiliency 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° Celsius (54.7° 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 blood, 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 lineage about 5.5 to 2 million years ago, went in a different direction.

Somewhere along the way, channichthyids shed their red blood cells and hemoglobin, the iron-rich protein found in red blood cells that transports oxygen throughout the body. They became the only vertebrates without red blood cells and hemoglobin—an oddity that manifests itself in their eerily colorless blood.

When **ANTARCTIC ICEFISHES**, as channichthyids are commonly known, were discovered in the 1920s, biologists were puzzled. Many assumed that the animals' curious lack of red blood cells had some adaptive value. Because they're so cold, Antarctica's waters are also incredibly rich in oxygen, and scientists thought that icefishes might soak up enough dissolved oxygen through their gills and skin to be able to afford to thin out their blood, saving energy by circulating a watered-down version instead. After all, some fishes in warmer waters show a decrease in red blood cells during colder seasons for this very reason.

As it turns out, that's not actually the case. Without hemoglobin, icefish blood is thinner but it carries less than 10 percent of the oxygen found in the veins of their red-blooded notothenioid cousins, putting significant pressure on the cardiovascular system to distribute enough oxygen. To compensate, icefishes have considerably larger hearts pumping higher volumes of blood, and spending about twice as much energy in the process. They also move that blood through wider blood vessels and devote a much denser network of blood vessels to sensitive organs like the retina of the eye than do red-blooded fishes. Being an ice-veined icefish turns out to be quite expensive, metabolically speaking. Instead of a clever adaptation, hemoglobin-less blood starts to look more like an evolutionary mishap. Still, these clear-blooded icefishes have thrived for millions of years—and it's hard to argue with success.

## FEAT 3: HIT REVERSE

It's one thing to act young and quite another to reverse the aging process altogether. Only one animal is known to have this remarkable ability: a small species of jellyfish, *Turritopsis dohrnii*, first discovered in the 1880s in the Mediterranean Sea.

Like all jellyfish, *Turritopsis dohrnii* begins life as a larva, called a planula, that develops from a fertilized egg. A planula swims at first, then settles on the sea floor and grows into a cylindrical colony of polyps. These ultimately spawn free-

swimming, genetically identical medusae—the animals we recognize as jellyfish—which grow into adulthood in a matter of weeks. Fully grown, *Turritopsis dohrnii* is only about 4.5 mm (0.18 inches) across, smaller than a pinky nail. A bright-red stomach is visible in the middle of its transparent bell, and the edges are lined with up to 90 white tentacles.

The medusae of *Turritopsis dohrnii* have an extraordinary survival skill. In response to physical damage or even starvation, they take a leap back in their development process, transforming 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 it—a rare process known as transdifferentiation—is of particular interest to scientists for its potential applications in medicine. By undergoing transdifferentiation, an adult cell, one that 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 stability 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, of 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.

## Life at the Limits: Stories of Amazing Species

On view in the LeFrak Family Gallery, fourth floor

Imagine holding your breath for an hour and a half. Enduring temperatures above 300° Fahrenheit and below -458° F. Or seeming to cheat death by repeatedly cloning yourself. *Life at the Limits: Stories of Amazing Species* explores 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.

The exhibition, co-curated by curators Mark Siddall, a parasitologist, and John Sparks, an ichthyologist, introduces visitors to many subjects from bizarre mating calls to extreme examples of parasitism, using specimens, videos, interactive exhibits, and models, including a climbable Hercules beetle. Live animals on display include the surprisingly powerful mantis shrimp, the nautilus, which uses jet propulsion to navigate its ocean habitat, and the axolotl, an entirely aquatic salamander that breathes through external gills.

*Life at the Limits* tells the stories of these and many more extraordinary creatures across the tree of life—and their extreme approaches to the unusual challenges of living on Earth.

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

Generous support for *Life at the Limits* has been provided by the Eileen P. Bernard Exhibition Fund.

*Life at the Limits* is proudly supported by Chase Private Client.

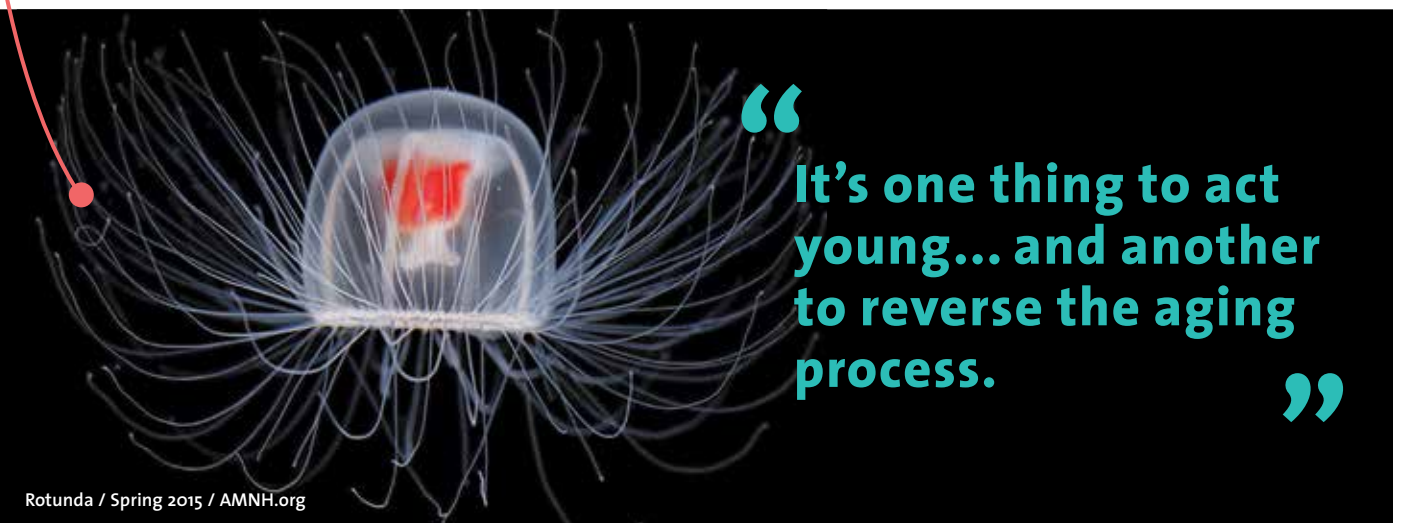
## Curator Lecture: Life at the Limits

Tuesday, May 12, 6–8 pm

Enter at 77th Street

Free for Adventurer-level Members and above

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



“It's one thing to act young... and another to reverse the aging process.”

# CURATORS' PICKS

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

**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 invade.

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.



1 Early in his career, Siddall was struck by the “incredible life cycle” of a **PARASITIC WORM** called *Ascaris lumbricoides*. Humans are infected when worm eggs, passed through feces, contaminate food. The eggs hatch out in the host’s small intestine, penetrate the intestinal wall, and hitch a ride to the lungs in the blood stream. Then they break out into the alveolar spaces of the lungs, causing irritation, which leads the infected person to cough, bringing the worms up the trachea to the esophagus. The precocious parasites are swallowed again to return to the stomach and arrive in the small intestine, where they started, and grow into adults. “That’s just amazing!” says Siddall.

2 Dr. Siddall is currently studying *Ozobranchus*, a group of **LEECHES** that feeds on the blood of turtles. *Ozobranchus margo* 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.

3 Siddall’s favorite vertebrate 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** 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.

1 Sparks was fascinated by **ELECTRIC FISHES**, especially the African mormyrids (elephantfishes) and South American gymnotiformes (knifefishes). In the deep, dark turbid rivers where these species live, vision is of little use. Both groups have independently evolved similar systems of communication via electric signals: gymnotiformes 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.”

2 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** (family Chlopsidae) 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 treehopper,” 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.

Photo of flying fish © Image Source/Corbis; treehopper © Piotr Naskrecki/Minden Pictures/Corbis



# The Imitators

## An exceptional mimic finds a fan

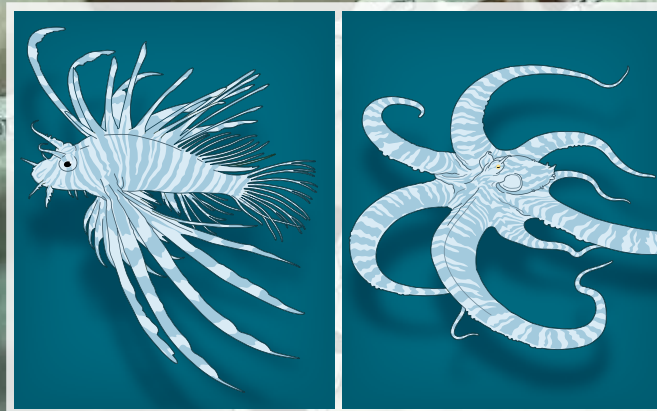
In nature, imitation is not just the sincerest form of flattery—it's often the best defense. By taking on the characteristics of a more threatening, often venomous, species, an animal can fool predators into staying away.

In 1998, researchers discovered a particularly gifted impersonator: *Thaumoctopus mimicus*. This 2-foot-long octopus species has been observed parrotting 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 hystrio*), 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.



### LIONFISH

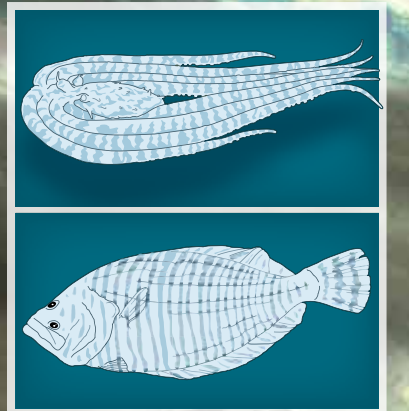
Lionfishes' long banded spines are beautiful and toxic, releasing a venom when puncturing the skin of predator or prey. To imitate, the octopus splays its arms.

**BANDED SEA SNAKE**  
To impersonate this venomous snake, the octopus pulls six of its arms out of sight, then stretches the remaining two in opposite directions.



### FLATFISH

Folding its arms behind its head, the mimic octopus moves its body in the manner of a swimming banded sole, a poisonous flatfish.



### HARLEQUIN JAWFISH

The harlequin jawfish spends most of its time near its burrow in the sand, where it can hide from predators. Blending in with an octopus arm offers protection in open water.



## Programs and Events

For more programs and to purchase tickets, visit [amnh.org/calendar](http://amnh.org/calendar).

For updates and reminders, sign up for monthly Calendar Highlights for Members by sending your membership number and request to subscribe to [members@amnh.org](mailto: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](http://amnh.org). Please have your membership number ready.

Availability may be limited. Please purchase tickets in advance.

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

Information about programs is current as of March 3, 2015. Please check [amnh.org/calendar](http://amnh.org/calendar) for updates.

## APRIL

### SciCafe: Why Walk on Two Legs?

**Wednesday, April 1**  
Free for 21+ with ID  
Join Museum Curator **Brian Richmond** and **Jeremy DeSilva** 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.

### Our Earth's Future

**Saturday, April 11**  
9 am–4 pm  
Free with application  
This one-day course explores the science of climate change—and how to talk about it. Will also be offered as an online course in April, May, and June. Visit [amnh.org/calendar](http://amnh.org/calendar) for details.

### How to Take a Picture of a Black Hole

**Monday, April 13**  
7:30 pm  
\$12  
**Shep Doleman** 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.

### Colonel Louis Cook: Revolutionary War Hero

**Tuesday, April 14**  
6:30 pm  
Free; reservations required at 212-769-5200  
Join Curator **Peter Whiteley** for an exploration of the life of Col. Louis Cook, Ataytaghronghta by his Mohawk name, simultaneously the highest-ranking African-American 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  
Take an after-hours journey of libations through the Museum and trace the history of traditional sake in Asia. This experience details culinary history, distillation processes, and more, with inspiration from the Museum's Stout Hall of Asian Peoples.



### Super Science Lab: Sea to Space

**Saturday, April 18**  
9 am–4 pm  
\$85  
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.



### Milstein 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.

## 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.



### Astronomy Live: How Big Is the Universe?

**Tuesday, April 21**  
6:30 pm  
\$12  
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.

### Behind the Scenes: Herpetology

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

### 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.

### Countdown to Zero: Defeating Disease

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

### Baby Animal Encounter

**Saturday, April 25**  
11 am (recommended for younger children), 1 pm, 2:30 pm  
\$10  
Meet some of nature's wildest and cutest youngsters, with animal expert **Jarod Miller**.



### Member Hall Tour: World of Sharks

**Sunday, April 26**  
10:30 am–noon or 2:30–4 pm  
Free  
Join a Museum tour guide and learn more about the evolution and diversity of sharks. Explore the Halls of Vertebrate Origins, Biodiversity, and the Milstein Hall of Ocean Life. For participants age 12 and up.



### Sackler Brain Bench Salon Series: Discovering the Mind

**Four Mondays, April 27–May 18**  
6–8 pm  
\$35 per session (\$105 series)  
Probe the science behind brain-based illnesses such as autism, ADHD, depression, and addiction in this salon-style series led by experts.

### 2015 Isaac Asimov Memorial Debate: Water, Water

**Tuesday, April 28**  
7 pm  
Live stream at [amnh.org/live](http://amnh.org/live)  
Watch the live video stream of this annual special event, hosted by **Neil deGrasse Tyson**, at [amnh.org/live](http://amnh.org/live).



### Lunchtime Bird Walks in Central Park

**Four Tuesdays, April 28–May 19**  
Noon–1:30 pm  
\$50  
Museum ornithologist **Paul Sweet** leads midday bird walks through Central Park.

## MAY

### Concrete Jungle: New York City and Our Last Best Hope for a Sustainable Future

**Sunday, May 3**  
2–4 pm  
Free  
Join **Sidney Horenstein** for a discussion of his new book, co-written with Curator Emeritus **Niles Eldredge**, which uses New York City as a microcosm to explore the relationship between cities, the environment, and the future of global biodiversity.



### Milstein Science Series: Sea Turtles

**Sunday, May 3**  
11 am–4:30 pm  
Free  
Sea turtles lived alongside dinosaurs 150 million years ago and today play a crucial role in oceans ecosystems. Learn more with **Eleanor Sterling**, chief conservation scientist at the Museum's Center for Biodiversity and Conservation; **Wallace J. Nichols**, scientist and author of *Blue Mind*; and **Michael Coyne** of [seaturtle.org](http://seaturtle.org).

### Natural Histories: 400 Years of Scientific Illustration from the Museum's Library

**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](http://amnh.org) for Member prices  
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.





**SciCafe: Cone Snails and Venom**

Wednesday, May 6  
7 pm

Free for 21+ with ID  
**Mandë Holford**, a marine biochemist, discusses her research into marine cone snails, the toxins they produce in their venom, and how those toxins may be used as therapeutics.



**Identification Day**

Saturday, May 9  
Noon–4 pm  
Free

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



**Member Hall 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 Akeley Hall of African Mammals and the bird and dinosaur halls.

**Frontiers Lecture: A Planet for Goldilocks**

Monday, May 11  
7:30 pm  
\$12

Finding so-called Goldilocks planets and evidence of life beyond Earth is a goal of science agencies worldwide. Kepler mission scientist **Natalie Batalha** describes the endeavor's latest discoveries and the possibilities for finding inhabited environments in the not-so-distant future.

**Curator Lecture: Life at the Limits**

Tuesday, May 12  
6–8 pm

Free for Adventurer-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.



**Birding in Prospect Park**

Saturday, May 16  
10 am–1 pm  
\$25

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



**Behind the Scenes: Earth and Planetary Sciences**

Wednesday, May 20  
6:30 pm, 7 pm, 7:30 pm  
\$30

Explore the labs and collections of the Department of Earth and Planetary Sciences with **Dr. Céline Martin** and Scientific Assistants **Saeybul Choe** and **Shawn Wallace**. For visitors ages 10 and up.

**Humans as Animals: Primate Politics, Culture, and Morality**

Thursday, May 21  
6:30 pm

Free; reservations required at 212-769-5200  
Biologist and primatologist **Frans de Waal** explores the similarities between humans and other primates in power politics, transmission of knowledge and habits, empathy, and sense of fairness.



Please check [amnh.org](http://amnh.org) for Member ticket prices for IMAX, 3D films, and the Space Show.

**LeFrak Theater Tiny Giants**

In an adventure of epic proportions, *Tiny Giants* reveals the astonishing lives of some very small animals.

**Hayden Planetarium Space Show: Dark Universe**

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

**Credits:**

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

*Generous support for Life at the Limits has been provided by the Eileen P. Bernard Exhibition Fund.*

*Life at the Limits is proudly supported by Chase Private Client.*

**Spotlight Asia**

Saturday, May 23  
Noon–5 pm  
Free

Bring your family and friends to enjoy a dynamic day featuring a variety of performances, new cultural expressions from across Asia, storytelling, and hands-on activities taught by master artists.



**Astronomy Live: Dance of the Planets**

Tuesday, May 26  
6:30 pm  
\$12

Using our Zeiss IX Planetarium projector, **Joe Rao** will demonstrate how the two brightest planets, Venus and Jupiter, slowly approach each other on the final night of spring for a spectacular conjunction. Meanwhile, shining sedately in the southern sky is the "Lord of the Rings," Saturn, displaying the best views of its rings in at least 10 years.

**Great Swamp**

Sunday, May 31  
8 am–6 pm  
\$95

The Great Swamp Refuge in Morris County, 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.

**JUNE**

**Behind the Scenes: Darwin Manuscripts**

Tuesday, June 2  
6:30 pm, 7 pm, 7:30 pm  
\$30

The Museum Library hosts the Darwin Manuscripts Project—a joint effort with Cambridge University Library to digitize and annotate original works by Charles Darwin. Join Director of Library Services **Tom Baione** and Director of Darwin Manuscripts Project **David Kohn** to view rare items from our Photographic Collections and to learn about Darwin's original works. For visitors ages 10 and up.

**SciCafe: Flipping the Genetic Switch**

Wednesday, June 3  
7 pm

Free for 21+ with ID  
Geneticist **Tuuli Lappalainen** from the New York Genome Center explains how genetic variants shape the way our genes are expressed and how her lab is seeking to uncover the "rules" of human variation.

**Rooftop Farming**

Thursday, June 4  
6–8 pm  
\$25

Discover a farming system right over our heads, at the Brooklyn Grange rooftop organic farm in Long Island City, Queens. Join the Museum for a tour and learn about the farm's daily operations, sustainable design, and environmental benefits. Then, enjoy a special mushroom cultivation workshop and bring home a mushroom kit.



**Water World: Immersive Dome Experience**

Monday June 8–Saturday, July 11

Splash down into the deep oceans to examine life underwater in this 10-minute geodome experience, which mixes science visualization and high-resolution video to reveal the many scales at which scientists explore our oceans and marine life.



**Birding and Wine in the Basha Kill with Paul Sweet**

Saturday, June 13  
8 am–6 pm

\$95  
**Paul Sweet**, collections manager in the Department of Ornithology, leads a birding excursion to the Basha Kill Wildlife Management Area, one of the largest freshwater marshes in New York State. The wetlands surrounded by deciduous woods are home to abundant and diverse wildlife, including nesting bald eagles and osprey. Following the walk members visit the Bashakill Vineyards for lunch and a wine tasting.

*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 sponsored 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 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, Mr. John J. Moores, Sr., 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](http://www.amnh.org)) in collaboration with the California Academy of Sciences, San Francisco, and GOTO INC, Tokyo, Japan.*



**Evening Nature Walk with Julie Feinstein**

**Wednesday, June 17**  
**6–8 pm**  
**\$25**  
 New York City is teeming with wildlife—but you need to learn where to look for it! Join **Julie Feinstein**, collections manager in the Sackler Institute for Comparative Genomics, on a wildlife exploration of Central Park. Identify birds and butterflies by the lake, look for interesting insects in the Shakespeare Garden, and learn about nature in the Museum’s backyard.

**Astronomy Live: Southern Skies**

**Tuesday, June 30**  
**6:30 pm**  
**\$12**  
 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 presenters **Christina Pease** and **Lydia Maria Petrosino** as they highlight some of these gems.



**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 Weston.

Our Earth’s Future courses were made possible in part by the Institute of Museum and Library Services under grant number MA-10-13-0200-13.

The Milstein Science Series is proudly sponsored by the Irma 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 Leoma 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 to the Ford Foundation.

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—bringing the finest 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.



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**Whale Watching Adventure**

**Saturday, June 20**  
**11 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 Sieswerda** 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! (Seeing whales is likely, but not guaranteed.)



**JULY**

**Journey to a Lost World with Paul Nascimbene**

**Saturday, July 25**  
**9 am–5 pm**  
**\$95**  
 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.

**Fun with Fossils with Carl Mehling**

**Saturday, June 27**  
**9 am–5 pm**  
**\$95**  
 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.

**APRIL**

**1 WEDNESDAY**  
 SciCafe: Why Walk on Two Legs? After-Hours Program

**11 SATURDAY**  
 Our Earth’s Future One-Day Course Adult Course

**13 MONDAY**  
 How to Take a Picture of a Black Hole Hayden Planetarium Program

**14 TUESDAY**  
 Colonel Louis Cook: Revolutionary War Hero Museum Lecture

**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 TUESDAY**  
 Behind the Scenes: Herpetology Member Program

How Big Is the Universe? Hayden Planetarium Program

**25 SATURDAY**  
 Spring Blooms Trolley Tour Member Program

Baby Animal Encounter Family Program

**26 SUNDAY**  
 Member Hall Tour: World of Sharks Member Program

**27 MONDAY**  
 Sackler Brain Bench Adult Course

**28 TUESDAY**  
 2015 Isaac Asimov Memorial Debate: Water, Water Special Event

Lunchtime Bird Walks Tuesdays through May 19

**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

**16 SATURDAY**  
 Birding 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 Pascoello, 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.



## 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.

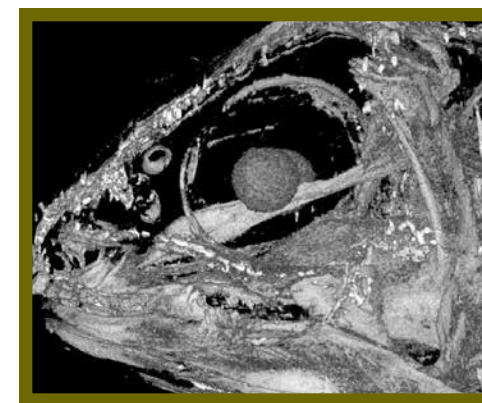
## Slice into Sections

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.



## 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 gleaned 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.



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](http://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.

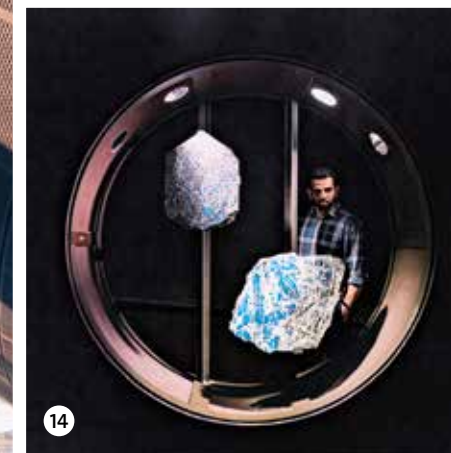
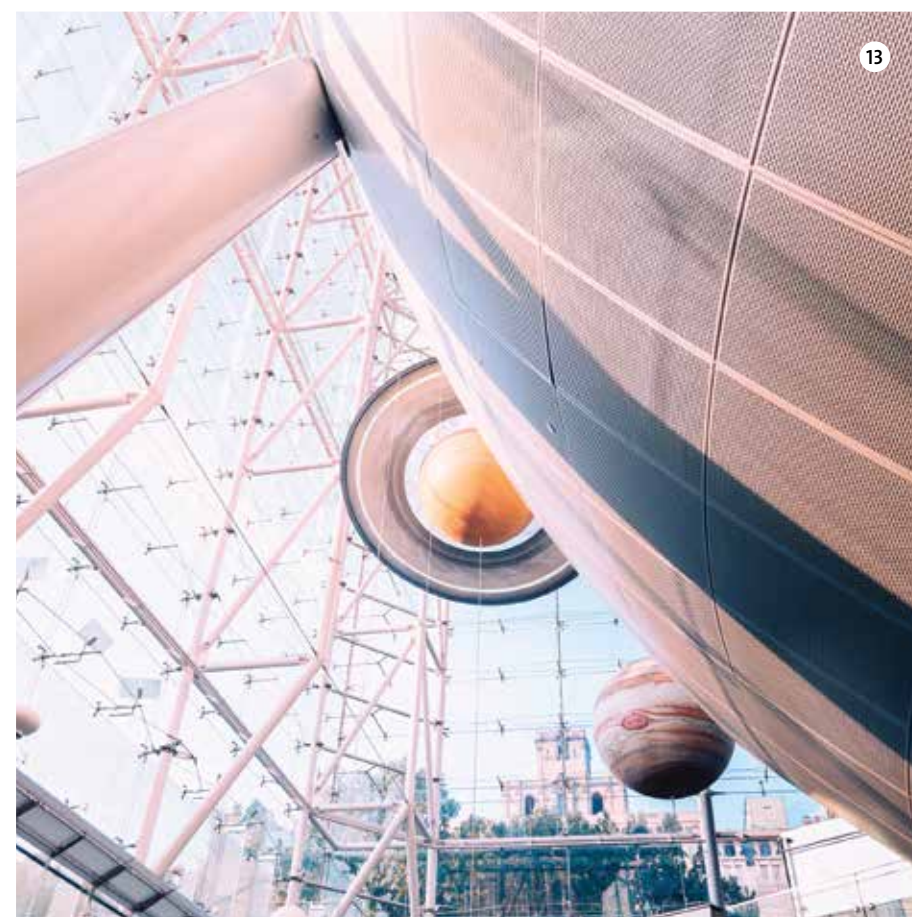
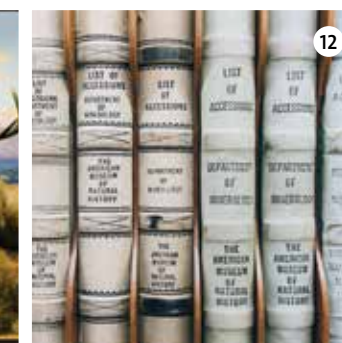
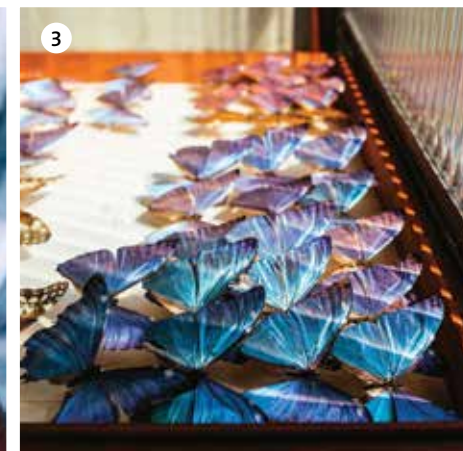


# Inside View

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](mailto:rotunda@amnh.org).



**#InsideAMNH with our favorite Instagram photographers**  
**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 @davidkrugman  
**11.** A visitor pauses in front of a diorama in the Bernard Family Hall of North American Mammals by @jnsilva.  
**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.



Central Park West at 79th Street  
New York, New York 10024-5192  
[amnh.org](http://amnh.org)



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*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.

## 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](http://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.