

150 YEARS

AMERICAN MUSEUM OF NATURAL HISTORY

ROTUNDA

Member Magazine
Summer 2019 Vol. 44 No. 3

L U N A R L E G A C Y

+ NEW FRONTIERS IN OCEAN EXPLORATION

From the President

Ellen V. Futter



The Museum's 150th anniversary coincides this summer with a milestone in space science: the 50th anniversary of the moment Neil Armstrong set foot onto the surface of the Moon. This July, the Museum will hold a festive and thrilling SpaceFest program celebrating this pivotal and inspiring event which, to many, seemed impossible until it happened, and looking ahead to future "impossibilities" of space exploration.

As we commemorate this historic event, we also remember the times in which it took place—the post-war period of tremendous U.S. achievement in science, fueled by visionary leadership and sustained investment in science; the "space race," which spurred unprecedented innovation in science and engineering around the world; the impact of astronomy and space science on the popular imagination; and the spirit of exploration, discovery, and optimism that had everyone glued,

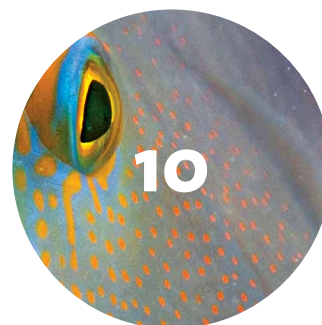
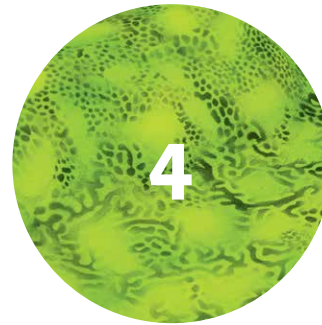
with awe, to their TV sets that July day. It was an ennobling, catalyzing moment for science, our nation, and the world.

As we face new horizons today, those times hold important lessons for us, including the urgency for redoubled investment in scientific research, the impact (and adventure!) of scientific discovery and science education, the centrality of science to society and to our everyday lives, and the importance of evidence- and fact-based inquiry to our shared well-being and future. Ultimately, the Moon walk reminds us how powerful and productive hope and ingenuity can be, as we face the seemingly impossible challenges of our own times—climate change, human health, environmental destruction, energy—and when, most dismayingly, science itself is under assault.

I hope you will join us for SpaceFest as we remember what it truly means to reach for the stars.

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ROTUNDA

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Revitalized Arthur Ross Hall of Meteorites Opens in July



Honorary Trustee Janet Ross pictured with Curator Denton Ebel, who oversaw the updates to the Ross Hall of Meteorites.

This summer, the Arthur Ross Hall of Meteorites, a gallery devoted to exploring the origins of solar systems, is undergoing a revitalization. The updates, in large part, reflect the astounding leaps that have been made in the field since the 2,700-square-foot gallery was last renovated in September 2005.

At the time, there had been no successful sample return missions—missions that collect extraterrestrial material and bring it back to Earth for study—since the last of the Apollo missions in 1972 (see p. 6 for more about celebrating the 50th anniversary of Apollo 11, the first sample return mission). All that was known about asteroids was known from specimens that had dropped to Earth through our atmosphere, including the Museum's 4.5-billion-year-old, 34-ton Ahnighito meteorite, the largest meteorite on indoor public view in the world. While scientifically valuable, each meteoritic specimen is by definition incomplete: it loses valuable cosmic data during its fiery descent.

That changed in 2010, when the Japanese Aerospace Exploration Agency (JAXA)'s Hayabusa probe returned particles collected on the Itokawa asteroid, the first "pure" samples from an

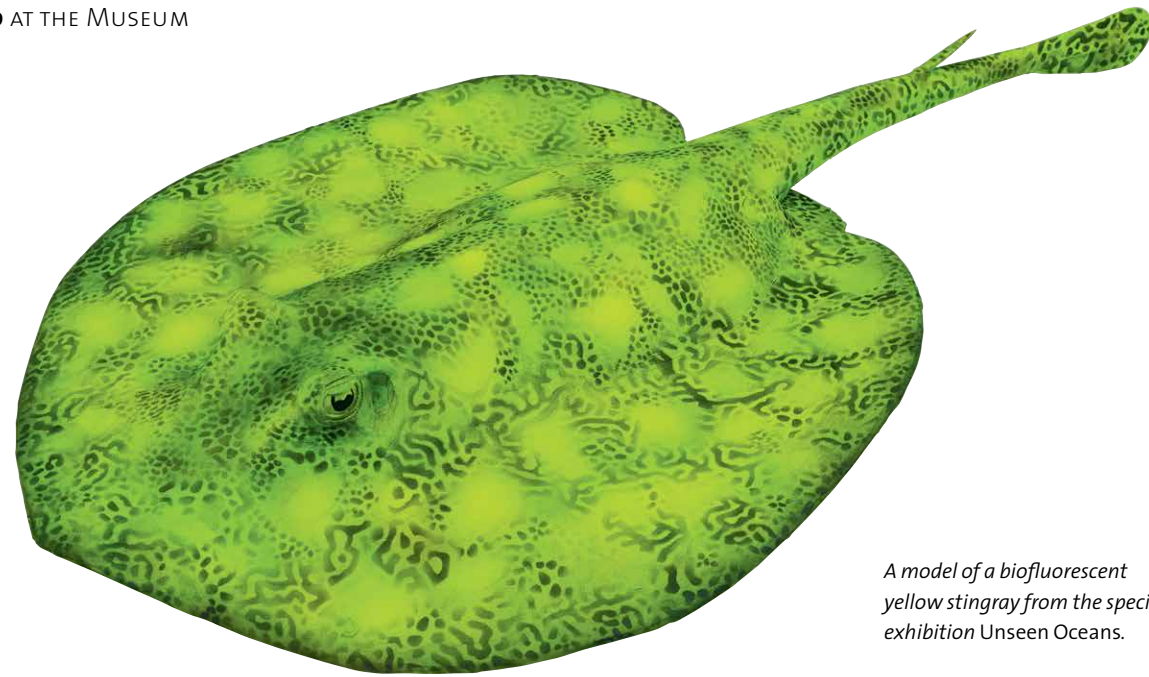
extraterrestrial body. Two other missions, Hayabusa2 and NASA's OSIRIS-REx—for which Museum Research Associate Harold C. Connolly Jr. is overseeing sample analysis—are currently in progress and expected to return in 2020 and 2023, respectively.

"With these latest updates to the gallery, we look to the future of sample return missions, to comets and asteroids not represented in our collections, and what we might find there," says Denton Ebel, curator in the Division of Earth and Planetary Sciences, who is overseeing the updates to the gallery, on view beginning July 20.

Updates to the gallery include a new touchscreen exhibit devoted to sample return missions that will let visitors compare the different missions, scale models of the Stardust, Hayabusa2, and OSIRIS-REx spacecraft, and an updated interactive about asteroid impacts. The gallery will also feature a new short film featuring Ebel with a closer look at what meteorites are, how scientists study them, and what meteorites tell us about the formation of the universe and our solar system.

Generous support has been provided by the Arthur Ross Foundation.

D. Finnin/©AMNH



A model of a biofluorescent yellow stingray from the special exhibition *Unseen Oceans*.

FAKING FOR FOOD

Scientists have suggested that the yellow stingray may attract prey by creating a shady area with its snout, offering a false sense of safe haven for small fish. It's also likely that yellow stingrays find food by waving their pectoral fins to expose worms, crabs, or small fish in sand.

STINGRAY SHUFFLE

Yellow stingrays are not considered aggressive but will use the venomous spine at the base of their tails in defense if disturbed. Waders in stingray habitats are advised to move their feet along the bottom to create flight-inducing vibrations. While the venom is not life-threatening, punctures can cause everything from itching to severe pain.

RAY VS. SKATE

Both fishes have eyes on the top of their heads, flat extended pectoral fins, and ventral gills. But skates are usually smaller and have shorter fleshy tails that lack the venomous barbs found in rays. Skates are also oviparous, laying internally fertilized eggs in an external egg case called a "mermaid's purse."

SHARP OBJECTS

Another feature unique to rays and the other cartilaginous fishes is the presence of dermal denticles, also known as placoid scales, on the surface of their skin. These are essentially tiny teeth. They are made up of a pulp cavity with nerves and blood vessels, dentine, and an enamel-like covering. The ray's venomous spine is itself a modified tooth.

Yellow Stingray

Among the spiral of biofluorescent fishes in the special exhibition *Unseen Oceans* is the striking species *Urobatis jamaicensis*, or yellow stingray. Like other biofluorescent fishes, yellow stingrays give off an eerie green glow when illuminated by blue or ultraviolet light—perhaps to attract a mate or as camouflage to avoid predators.

Yellow stingrays inhabit the waters throughout the Gulf of Mexico, in the Atlantic Ocean from North Carolina to Florida, and in the Bahamas and the Caribbean. Despite its common name, this species' dorsal (top-side) patterns come in a variety of colors, from dark green or brown on light backgrounds to white, yellow, or golden spots on dark green or brown backgrounds. These dappled patterns help the stingrays lay low by blending into coral reefs and sandy sea bottoms. Meanwhile, their ventral side is typically off-white with hints of yellow, green, or brown.

Stingrays have been likened to "flattened sharks," and they happen to be closely related. In contrast to bony fishes, sharks and rays are both cartilaginous and belong to an ancient group called elasmobranchs. Fishes in this group have skeletons that are composed of softer structural material similar to that found in human noses, ears, and joints. Elasmobranchs also lack the air bladder that keeps many other fishes neutrally buoyant.

And unlike most bony fishes in which females release eggs for the males to fertilize externally, yellow stingrays reproduce by copulating. During mating, male yellow stingrays have been observed grabbing the female by biting midway into her pectoral fin, then swinging beneath her, ventral side to ventral side. In this position, the male inserts one clasper into the female cloaca to deposit sperm. Females nourish the embryos in a yolk sac, as opposed to a placenta, and give birth to live young.

Yellow stingrays are relatively small—only 30 inches across compared to larger 7-foot-wide short-tail stingrays or the massive 18-to-25-foot-wide manta ray. But like most rays, the yellow stingray has a large brain—comprising 1 to 2 percent of its body weight—and its cerebellum has three separated lobes, offering researchers a rare chance to study the connection between various behaviors and brain activity.

Don't miss the special exhibition *Unseen Oceans* before it closes August 18. Members see it free.

C. Chesek/AMNH

Shark-Tooth Sword

Sharks' razor-sharp teeth help these predators dominate the waters. That hasn't gone unnoticed by humans: in the 19th century, the Indigenous peoples of the Republic of Kiribati, an archipelago east of Papua New Guinea, relied on shed shark teeth to craft weapons, including this sword from the Museum's Anthropology Collection, which is lined with rows of serrated shark teeth attached with braided coconut fiber.

Such weapons can vary greatly depending on the type of combat they were made for and the age and sex of the warrior, according to an article by Jean Michel Massing in the journal *Pacific Arts*. The largest weapons include spears that measure 10–15 feet long and are topped with barbs from another group of cartilaginous fish, stingrays. A three-pronged weapon is distinctive for its cross-guards lined with shark teeth. And some smaller objects functioned as multi-purpose tools used either as an eating utensil or a weapon.

"There are over 100 shark-tooth weapons from Kiribati in the Museum's Pacific Ethnology Collection, from 12-inch knives to 14-foot thrusting spears," says Paul Beelitz, director of collections and archives in the Museum's Division of Anthropology.

Today, these artifacts offer an extensive visual record of traditional Kiribati warfare. And because they include stable biological materials, they are also helping researchers track changes in the region's biodiversity over time.

Museum Research Associate Joshua Drew and colleagues have closely examined weapons and cross-referenced these artifacts with holdings in the Museum's Ichthyology Collection to identify which shark species' teeth were used in making the weaponry. The team discovered that teeth from two species of shark—*Carcharhinus obscurus* and *Carcharhinus sorrah*—had been used extensively in Kiribati weapons. But these two species can no longer be found in contemporary surveys of local shark populations, indicating a significant change in the region's marine apex predators since the implements were crafted.

"We now know that there were two species of shark living in the waters around Kiribati 150 years ago, but we wouldn't have known about them in any other way than by examining these weapons closely," says Drew.

Visit the Margaret Mead Hall of Pacific Peoples to see additional shark-tooth weapons from Kiribati.

SHARK CULTURE

Sharks played a role in multiple facets of Indigenous Kiribati culture, from origin stories to ceremonies that signified the right of passage for young men into adulthood. Special implements were also produced for the purpose of shark fishing, such as whalebone clubs and multi-sided bludgeons.

SUIT OF ARMOR

To protect themselves in battle, Kiribati warriors constructed full-body armor made of coconut-husk fibers to cover their arms, core, and legs. The suit typically included stiffened armor that covered the chest as well as the back of a wearer's head and neck. Armor often included materials from other marine species: for example, the stretched skin of the porcupine fish was used as a helmet.

WOMEN WARRIORS

Battle wasn't solely reserved for males. Women often led the charge in large-scale conflicts armed with smaller shark-tooth weapons that were set with one or more teeth.

CAREFUL HANDLING

An extensive collection of shark-tooth weapons came to the Museum between 1891 and 1893. The weapons were made around 1850–1890 and require extra special handling. The coconut fiber holding the teeth in place has become very brittle with age, according to Beelitz, and the teeth can easily become dislodged.

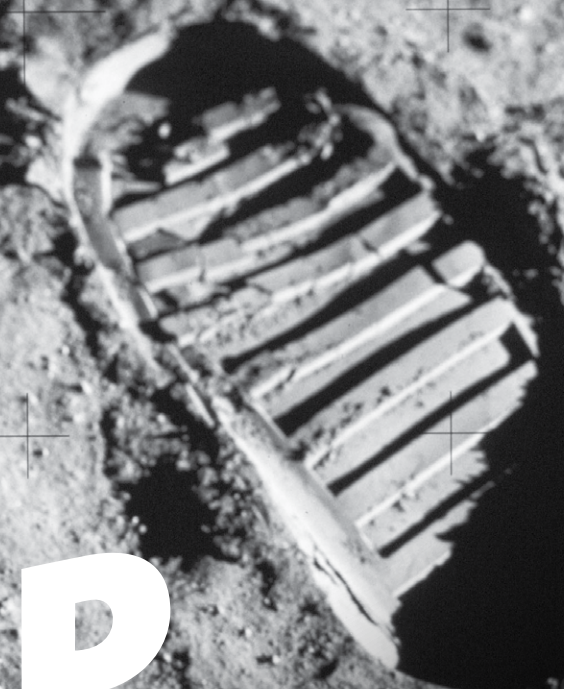


Catalog no. ST/1275.

SAVE THE DATE

SPECIAL ALL-DAY PROGRAM: SPACEFEST, JULY 20

FIFTY YEARS
 SINCE THE
 FIRST STEP



CELEBRATING
 THE
 MOON
 LANDING
 AND
 THE
 SPIRIT
 OF
 EXPLORATION



ON AN OTHERWISE ORDINARY SATURDAY morning in November 1969, the Museum received a special delivery from NASA: a glass dome containing nitrogen and a 0.75-ounce lunar rock.

According to *The New York Times*, it arrived with less than 24 hours' notice, so a makeshift display had to be hastily arranged in the Theodore Roosevelt Memorial Hall. That Sunday, the paper reported "a tiny piece of the Moon drew the largest crowd in the 100-year history of the American Museum of Natural History," with more than 42,000 people streaming in.

Visitors came from the neighborhood, or from as far as an hour away. All wanted to be part of history—to see, in person, a souvenir from the Moon landing that had electrified the nation a few months earlier. Some were inevitably underwhelmed, having imagined that a real piece of the Moon would glow with "purple spots or green stripes" that had only seemed black-and-white on their television sets. "Its appearance is rather disappointing," Janet Wagner of Roslyn, Long Island, told *The New York Times*. "But it's the whole thought of it that's important. It's very moving as a symbol."

This summer marks the 50th anniversary of the Apollo 11 landing, which fulfilled President John F. Kennedy's ambitious goal to send a crewed spacecraft to the Moon. When Neil Armstrong stepped onto the Moon's surface on July 20, 1969, it was an astounding achievement. The observations and specimens from Armstrong's and Edwin "Buzz" Aldrin's 21-hour-and-56-minute-long stay on the Moon—which included setting up surface experiments and gathering 48.5 pounds (22 kilograms) of rock, soil, and dust samples over approximately two hours—were just the beginning.

"The Apollo 11 mission provided an enormous sense of excitement and accomplishment to Americans at the time," says Curator Michael Shara, who oversaw the 2010–2011 exhibition *Beyond Planet Earth: The Future of Space Exploration*. "Even though the mission was completed 50 years ago, amazingly it's still bearing fruit. What Apollo taught us has given us a far better understanding of the origins of the solar system."

Once the crew returned to Earth on July 24, the collected material set off a research race and led to five additional landings that yielded more specimens and more amazing discoveries. Among them: analysis of the chemical composition of lunar rocks helped strengthen the theory that the Moon was actually a chip off the young Earth.

Researchers now think that soon after the formation of the solar system, Earth was struck by a Mars-sized object, intimately mixing the two bodies. Some of the resulting vapor and rock later congealed into the single satellite that is our Moon today. This origin story would explain why the Moon doesn't have a large iron core and is mostly composed of materials found in Earth's crust, and why the ratios of many isotopes on the Moon's surface are identical to those found in rocks on Earth. "It was a stunning finding," says Shara.

Above: In November 1969, a Moon rock sample from the Apollo 11 mission was displayed at the Museum, drawing record attendance.

Previous Page: Aldrin's footprint on the surface of the Moon, photographed using a 70 mm lunar surface camera during the Apollo 11 mission.

Research based on materials gathered during the Apollo missions continues to this day. "The Apollo program was the beginning of a great age of exploration, and sample-based science is entering a whole new phase," says Denton Ebel, curator in the Division of Earth and Planetary Sciences.

"With very few exceptions, no other scientific expedition is still producing this much new science," adds Shara. "It's a great example of the value of unique and rare specimens that exist in collections like those found here at the Museum—that you can go on studying them for a long time. The specimens collected 50–100 years ago—like the Museum's dinosaur specimens—are still being analyzed today and giving us new information. These Moon rocks have not yet given up all of their secrets, and they likely still won't 50 years from now."

In March, NASA announced that it would open a previously unstudied cache of Moon rocks and a sedimentary core from the Apollo missions for study. "Samples were deliberately saved so we could take advantage of today's more advanced and sophisticated technology to answer questions we didn't know we needed to ask," said Lori Glaze, acting director of NASA's Planetary Science Division in Washington, D.C.

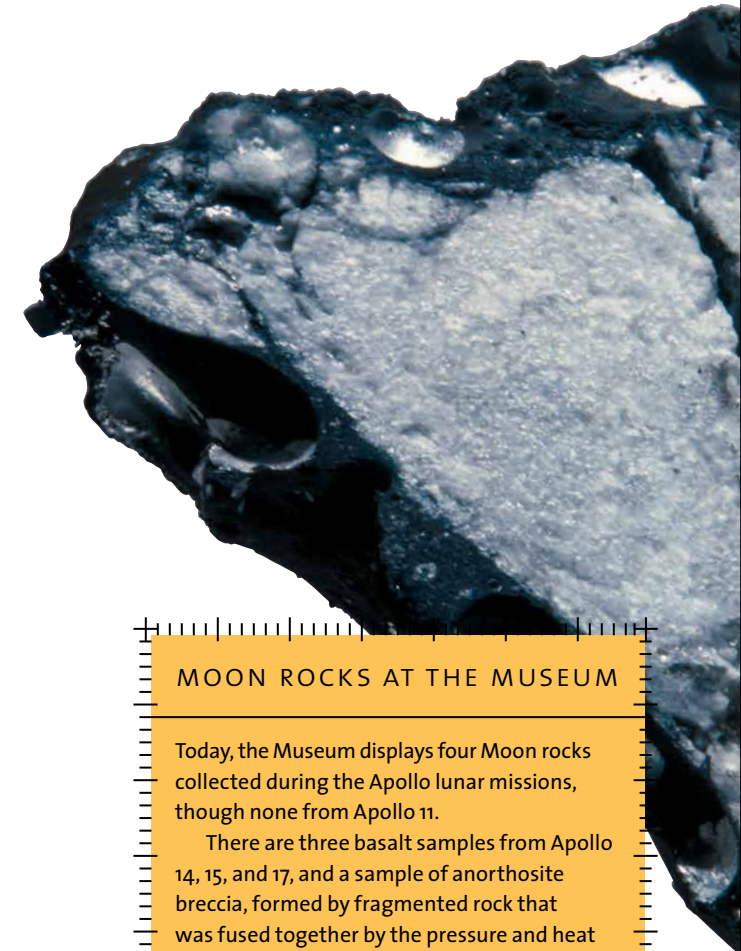
"The specimens collected 50–100 YEARS AGO—like the Museum's dinosaur specimens—are still being ANALYZED TODAY and giving us new information."

+ MICHAEL SHARA

While NASA has not returned to the surface of the Moon since 1972, it has sent missions to farther destinations in the solar system, including Mars, Saturn, and asteroids like Bennu. That has left a vacuum in lunar exploration that other nations are beginning to fill. In January, China succeeded in landing a robotic rover on the Moon's far side, in the largest-known impact crater in our solar system, the Von Kármán crater. Scientists think the far side's rocks preserve important clues about the early solar system. The mission also carried plant seeds that successfully sprouted, and while the seedlings didn't live long, the mission was the first ever to grow organic matter on the Moon. China's future goals include locating ice deposits on the far side, setting up a lunar base, and putting astronauts on the Moon within 10 years.

"At some point humans are going back," says Shara. "And whoever gets there first will spur the others. There's great astronomy to be done there in future." 🌕

Celebrate the Moon landing anniversary and find out more about the future of space exploration at the July 20 SpaceFest, part of the Museum's 150th anniversary programming.

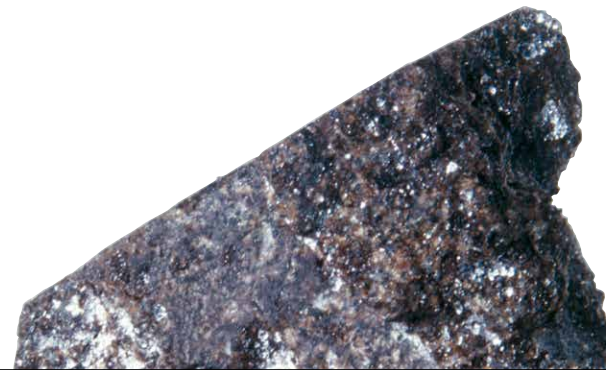


MOON ROCKS AT THE MUSEUM

Today, the Museum displays four Moon rocks collected during the Apollo lunar missions, though none from Apollo 11.

There are three basalt samples from Apollo 14, 15, and 17, and a sample of anorthositic breccia, formed by fragmented rock that was fused together by the pressure and heat of an asteroid impact, from Apollo 16. The specimens are housed in cases in the Rose Center for Earth and Space and the Ross Hall of Meteorites, which reopens this month after a revitalization. The hall will feature new models of spacecraft from recent specimen retrieval missions, interactives exploring missions to asteroids and comets, and a film about meteorites featuring Curator Denton Ebel.

See p. 3 for more about updates to the Ross Hall of Meteorites.



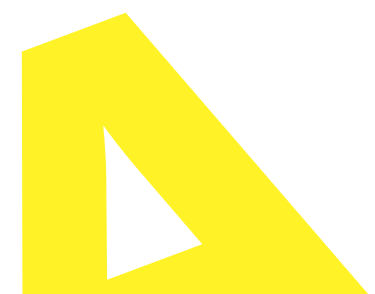


CAPTURED ON CAMERA

Fantastic footage

reveals new

ocean frontiers



Along Australia's Great Barrier Reef, a small gray-and-white, orange-spotted tuskfish (*Choerodon anchorago*) has selected a clam for dinner. For any animal without thumbs, getting to the meat inside is a challenge. But this fish has a plan: it carries the clam in its mouth to a bowl-shaped coral nearby and proceeds to hurl it against a small protrusion, over and over, until the shell gives way.

It may not seem like it at first glance, but this small feat of ingenuity is a big deal when it comes to the known behaviors of fishes, and an even bigger deal for filmmakers of the new documentary *Oceans: Our Blue Planet*. This is the first time cameras have captured a fish using a tool. The film is the latest giant-screen film to show in the LeFrak Theater, part of a partnership between the American Museum of Natural History and OceanX, an initiative of the Dalio Foundation, to advance ocean research and exploration. (OceanX is also the lead funder for the Museum's current *Unseen Oceans* exhibition and educational resources.) *Oceans: Our Blue Planet* features several other firsts that provide new insight into the behaviors of marine organisms and the diversity of their habitats. Dolphins in Egypt's Red Sea are captured playfully rubbing their bodies against bush-like corals called gorgonians, which are covered in a mucus layer known for its antimicrobial properties. If the dolphins are using the gorgonians to protect themselves against infection, could humans do this, too?

In the kelp forests off the coast of South Africa, filmmakers turn their lenses to an octopus looking to dodge hungry pajama sharks. Rather than swim away, the octopus collects shells and rocks with its suckers and curls itself into a ball to hide beneath them. While the sharks can still sense the octopus nearby, it's effectively camouflaged and armored by the shells, allowing for a stealthy escape.

But just as it is important to take a closer look at our marine neighbors, so too is it to dive deeper into their habitats so we can better understand Earth's marine ecosystems. The giant kelp stalks that the armored octopus calls home can grow up to 200 feet high, and like all marine forests, they produce just as much oxygen as those on land. While coral reefs, like the ones where the orange-spotted tuskfish hunts for clams, occupy less than 1 percent of the seafloor, they are home to a quarter of all known marine species. With ultra-sensitive microphones, filmmakers can now hear some of them for the first time.

Diving deeper still, a team of scientists and filmmakers journey almost half a mile down to the seafloor, where there are more coral species to be found than in shallow reefs. There are dancing white yeti crabs (*Kiwa hirsuta*) that survive by eating the bacteria that grows on their arms and claws, barreleye fish (*Macropinna microstoma*) with translucent heads that rotate their extremely-light sensitive eyes to look for food overhead, and tubes of jelly, 6 feet long, called pyrosomes.

But along the muddy seafloor, the cameras catch a different kind of life cycle: the violent eruptions of methane volcanoes, with exploding gas bubbles the size of basketballs rising from decaying organic matter on the seafloor. This may seem like a place too hostile for any life form to thrive, but the plethora of organisms, captured for the first time ever in *Oceans: Our Blue Planet*, remind us that there is still so much more marine life to be explored. 🌐

Oceans: Our Blue Planet is now screening in the LeFrak Theater in 2D and 3D. Free or discounted tickets for Members.

Photograph by Alex Vail copyright BBC NHU 2017, © BBC Studios. Photography by Luis Lamar 2017 copyright BBC NHU 2017, © BBC Studios



Ocean Science at the Museum

NATHALIE GOODKIN
Assistant Curator, Department of Earth and Planetary Sciences
Research Interests: How corals can be used to look back in time at climate conditions.
Recent Expeditions: Tobago

ESTEFANÍA RODRÍGUEZ
Associate Curator, Division of Invertebrate Zoology
Research Interests: Sea anemones, with a focus on polar and deep-sea species.
Recent Expeditions: Panama, Antarctica

JOHN SPARKS
Curator, Department of Ichthyology
Research Interests: Bioluminescence and biofluorescence in marine fishes.
Recent Expeditions: Solomon Islands, Greenland

Programs and Exhibits

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

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

Tickets

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

Availability may be limited. Please purchase tickets in advance.

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

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

Information about programs is current as of June 18, 2019. Please check amnh.org/calendar for updates.



EXHIBITIONS

T. rex: The Ultimate Predator Free

Everyone knows *Tyrannosaurus rex*. But did you know how this mega-predator evolved to become the most fearsome carnivore of the Mesozoic? Meet the entire tyrannosaur family through fossil casts and life-sized models, engaging interactives, and a VR experience.

Unseen Oceans Closes Sunday, August 18 Free

Meet the elusive giants of the sea, including whales, sharks, and giant squid; sink beneath the waves in a virtual submersible theater; and marvel at the vivid fluorescence displayed by marine animals but invisible to us—until now.

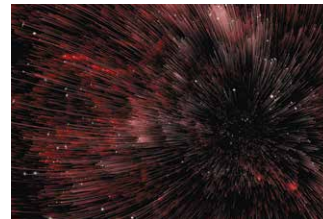


Oceans: Our Blue Planet Screening daily in 2D and 3D

Embark on a global odyssey to discover the largest and least-explored habitat on Earth. From the coastal shallows to deeper, more mysterious worlds, see the untold stories of the oceans' most astonishing animals. Captioning and audio devices are available.

Dark Universe

Narrated by Neil deGrasse Tyson, Frederick P. Rose Director of the Hayden Planetarium, this 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 find out what scientists are learning about dark matter and dark energy. Captioning devices are available.



Exhibition Credits:

Major funding for *T. rex: The Ultimate Predator* provided by the *Lila Wallace-Reader's Digest Endowment Fund*.

Generous support also provided by: *Dana and Virginia Randt Chase Private Client*

Virtual reality experience created in collaboration with *HTC VIVE*.

Lead funding for *Unseen Oceans* and its educational resources is provided by *OceanX*, an initiative of the *Dalio Foundation*.

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

Unseen Oceans is generously supported by *Chase Private Client*.

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.

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

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

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

D. Finnin/©AMNH, Photography by Rachel Butler copyright BBC NHU 2016. ©AMNH

R. Mickens/©AMNH, D. Finnin/©AMNH, Brendan Lally/Flickr

JULY

Swimming with Giants in 360 Through Sunday, August 18
Daily, 11 am–4 pm
Free

Milstein Hall of Ocean Life

Are you ready to swim with some of the giants of the deep? Virtually explore the world under water and sample some of the wonders that await in the *Unseen Oceans* exhibition.



Manhattanhenge
Thursday, July 11
7 pm
\$12

As the Sun sets on July 11, it aligns with Manhattan's east-west numbered streets. Astrophysicist **Jackie Faherty** will be your guide to the history and astronomy behind this fascinating phenomenon in a special presentation at the Hayden Planetarium.

Program Credits:

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

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

Manhattanhenge is sponsored by *JetBlue*.

SpaceFest
Saturday, July 20
11 am–5 pm
Free

From the Moon to Mars and beyond, join us for a family-friendly day of celebration of space exploration past, present, and future. Highlights include:

Main Stage Programs:

Director of Astrovisualization **Carter Emmart** presents a digital recreation of the iconic Apollo 11 mission's flight and landing; Astrophysicist **Jackie Faherty** introduces us to the Gaia data set, which includes over 1.5 billion stellar distances; **Story Pirates** lead an interactive adventure.

Solarium: This innovative video art taps into a vast reservoir of imagery from NASA's Solar Dynamics Observatory.

Moon to Mars with Carter Emmart
5 pm

Catch **CAPCOM GO! The Apollo Story**, an immersive historical documentary that showcases the achievements of the Apollo program. Visit the landing sites of select Apollo missions and explore Mars using OpenSpace visualization software with **Carter Emmart**.

Support for accessibility initiatives at the American Museum of Natural History has been provided by the *Filomen M. D'Agostino Foundation*.

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

Excerpts from *Moby-Dick*, In Concert Under the Whale
Friday, July 26,
and Saturday, July 27
8:30 pm (Doors open at 8 pm)
\$120

The American Museum of Natural History in association with the American Repertory Theater (A.R.T.) at Harvard University presents a live musical theater event: staged excerpts from *Moby-Dick*, a musical adaptation of Herman Melville's 1851 classic novel. Reimagined for a contemporary audience by Tony-nominated composer Dave Malloy (*Octet*; *Natasha, Pierre & The Great Comet of 1812*) and Tony-winning director Rachel Chavkin (*Hadestown*, *Natasha, Pierre & The Great Comet of 1812*), *Moby-Dick* will be presented as an immersive performance under the whale in the Museum's Milstein Hall of Ocean Life. Featuring a cast of 11 and a live seven-piece orchestra performing a score that draws on a myriad of musical genres, *Moby-Dick* plays at the Museum for two nights only.

The performance will be 90 minutes with no intermission. Both performances will provide American Sign Language (ASL) interpretation.

Accessibility Programs

To learn more, email accessibility@amnh.org or call 212-313-7565. Visitors who are blind or partially sighted are invited to attend tours highlighting exhibits through verbal descriptions and touchable objects. The Museum also offers tours for both deaf and hearing audiences that are simultaneously signed and spoken. And our Discovery Squad Tours were developed specifically for families affected by autism spectrum disorders.



Discovery Room

Free
Monday–Sunday,
10:30 am–1:25 pm and
2:25–5:10 pm

The Discovery Room offers families, and especially children ages 5–12, an interactive gateway to the wonders of the Museum and a hands-on, behind-the-scenes look at its science.

FALL BIRD WALKS

Bird Walks are now just for Museum Members. Registration for September begins July 22. Visit amnh.org or call 212-769-5200.



Mighty Mastodon

As the Museum celebrates its 150th anniversary, each issue of *Rotunda* will bring you little-known facts about the Museum's beloved exhibits.

One such icon is the Warren mastodon, which stands back-to-back with the mammoth fossil in the Paul and Irma Milstein Hall of Advanced Mammals. Here are a few fascinating facts about this ancient proboscidean's history.

CAPTURED IN TIME

This fossil skeleton of an American mastodon (*Mammuth americanum*) was discovered in 1845 on a farm near Newburgh, New York. Based on its position, this distant cousin of the elephant became mired in mud some 11,000 years ago and died while struggling to extricate itself. Most of the skeleton was embedded in a 3-foot layer of shell marl—a lakebed sediment of mostly mollusk shells—beneath a foot of red moss and 2 feet of peat, which protected the bones from decomposition and scavengers for millennia. Lacking only a few toe bones and tail vertebrae, the skeleton is exceptional for being so nearly complete.



IMITATION TUSKS

In 1849, the Warren mastodon was mounted for display at the private Warren Museum of Natural History in Boston, where it remained until it was acquired by the American Museum of Natural History in 1906. The mastodon's tusks began to disintegrate immediately after excavation, so to prevent further damage, the Warren Museum's founder, surgeon and anatomist John C. Warren, supervised the sawing off of about 3 feet of the tusks. Papier-mâché tusks were created for the display, measuring slightly too long at 11 feet.

CLEAN SLATE

Before going on display at the Museum, the skeleton required an intense cleaning because the mastodon had been covered with a thick coat of black varnish. The bones were immersed in large vats of pure benzene for weeks and then vigorously scrubbed with pure spirits of alcohol. According to a contemporary account, "One by one the bones emerged from this prolonged and very expensive bath in all the purity of color that characterized the skeleton when it was exhumed."

FREE FOR MEMBERS

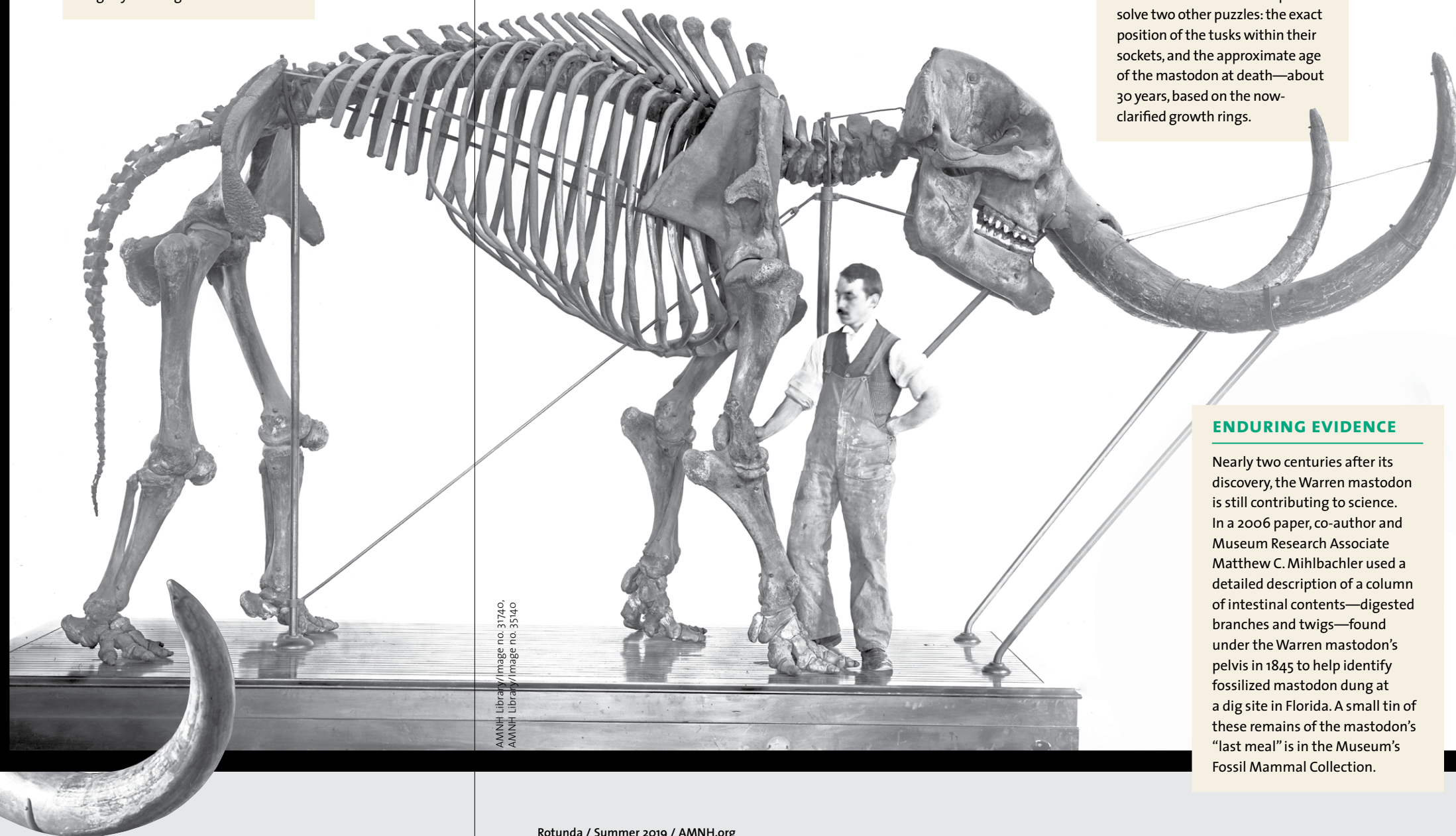
SEE THE WARREN MASTODON

DELICATE DETECTIVE WORK

The preserved tusk fragments accompanied the mastodon to New York, where Museum preparators discovered a splinter of tusk that helped piece the full tusks together. "There was great rejoicing in the lab ... because it enabled us to determine positively the length of the tusks as 8 feet 6 inches," according to an account in a Museum publication. Having the correct dimensions helped to solve two other puzzles: the exact position of the tusks within their sockets, and the approximate age of the mastodon at death—about 30 years, based on the now-clarified growth rings.

ENDURING EVIDENCE

Nearly two centuries after its discovery, the Warren mastodon is still contributing to science. In a 2006 paper, co-author and Museum Research Associate Matthew C. Muhlbachler used a detailed description of a column of intestinal contents—digested branches and twigs—found under the Warren mastodon's pelvis in 1845 to help identify fossilized mastodon dung at a dig site in Florida. A small tin of these remains of the mastodon's "last meal" is in the Museum's Fossil Mammal Collection.



AMNH Library/Image no. 31740.
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Membership

Central Park West at 79th Street
 New York, New York 10024-5192
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On July 20, 1969, the Apollo 11 mission successfully landed on the Moon. Read more about the legacy of the Apollo 11 Moon walk on p. 6.

General Information**HOURS**

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

ENTRANCES

During Museum hours, Members may use the Member entrance, located on Central Park West (ground level via the driveway), the 81st Street entrance, and the subway entrance (lower level). On weekends, the 77th Street entrance is also designated for Members.

RESTAURANTS

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

MUSEUM SHOPS

The Museum Shop, Dino Store, Planetarium Shop, Cosmic Shop, *T. rex* Shop, *Unseen Oceans* Shop, and Online Shop (shop.amnh.org) offer Members a 10-percent discount.

PHONE NUMBERS

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

TRANSPORTATION AND PARKING

Subway: **B** (weekdays) or **C** to 81st Street; **1** to 79th Street, walk east to Museum
 Bus: M7, M10, M11, or M104 to 79th Street; M79 to Central Park West
 Parking Garage: Open daily, 8 am–11 pm; enter from West 81st Street. Members can park for a flat fee of \$10 if entering after 4 pm. To receive this rate, show your membership card or event ticket when exiting the garage.

ACCESSIBILITY

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