



AMERICAN MUSEUM OF NATURAL HISTORY

ROTTUNDIA

Member Magazine
Fall 2017 Vo. 42 No. 4

**OUR
SENSES:
AN
IMMERSIVE
EXPERIENCE
OPENS
THIS
FALL**

From the President

Ellen V. Futter



As you hold this issue of *Rotunda* and read this message, maybe even sipping a cup of coffee as you do so, you are probably not thinking about the extremely complex process that allows you to take in information—in this case how the paper feels between your fingers, what the words and pictures say, how the coffee tastes—and make meaning out of it.

I'm alluding to the senses, of course, the amazing systems through which we perceive and understand the world around us.

This fall, the Museum is presenting the major exhibition *Our Senses: An Immersive Experience* that will explore how our sensory organs and our brains work together in processes that have adapted over millennia to help our ancestors and us survive. This exhibition builds upon the highly successful *Brain: The Inside Story*, which explored

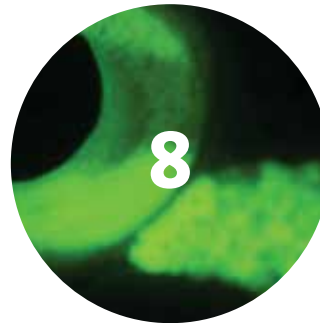
why our brains evolved the way they did and how their complex systems work.

Through highly interactive, fascinating, and fun experiences, visitors to *Our Senses* will be able to test their own perceptions and learn how their senses function. What happens, for instance, when our senses disagree? How do other animals perceive the same objects? Why can't we perceive some things, like electrical fields? And how do our brains even sort through and prioritize the unrelenting onslaught of stimuli in modern life?

Our Senses will answer all of these questions, and perhaps encourage you to think a bit more about how you receive and process information using extraordinary evolutionary adaptations that enable us humans not merely to exist but to enjoy life and thrive.

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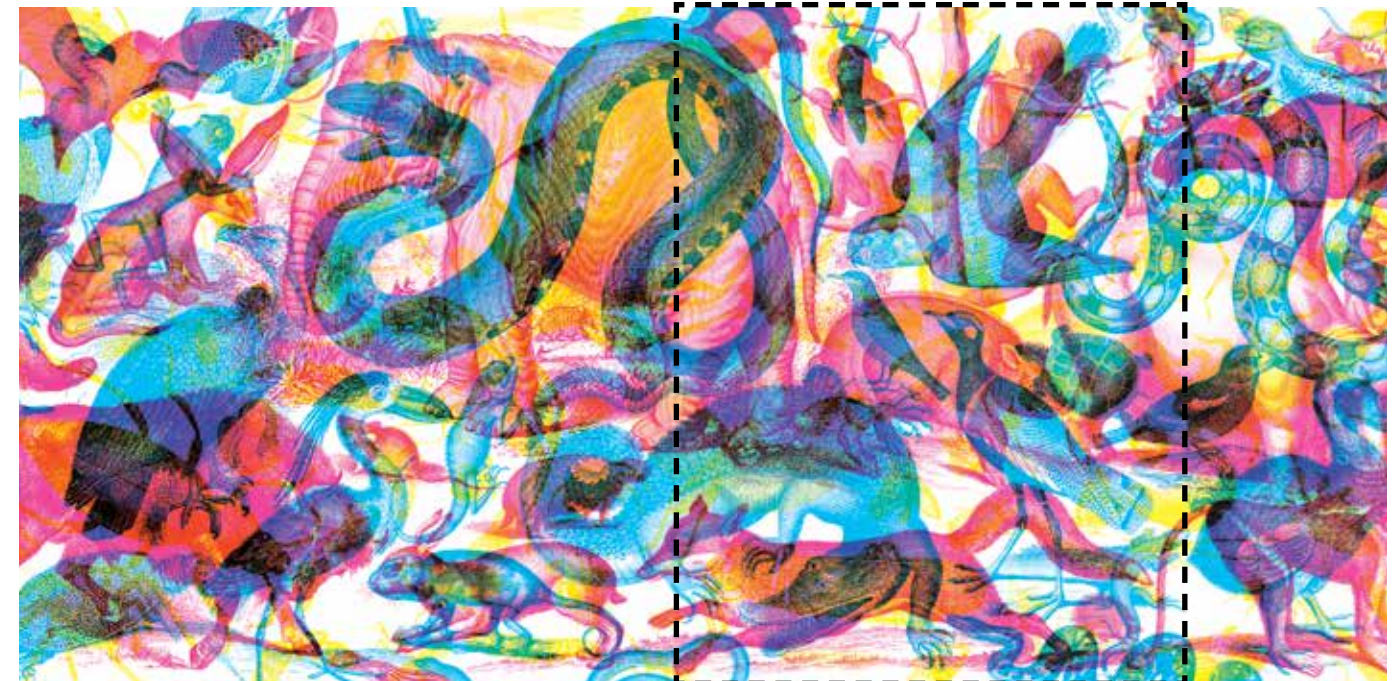
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Photos AMNH/D. Finnin and R. Micklens except fish eye (D. Gruber) anechoic chamber (Karen Kasmauski/Getty Images)

Our Senses: An Immersive Experience Opens This Fall



What you see depends on the light. This illustration reveals what the cover, shown as if under red light, "hid" from view.

Those bunches of yellow flowers you passed by this morning at the corner deli? The muffled announcements you strained to hear on your train this morning? The sour-sweet wafts of garbage on New York City sidewalks? Every day, we perceive the world around us through some or all of our senses—including sight, smell, hearing, touch, taste, and balance. But as it turns out, "reality" isn't ever exactly what it seems to be.

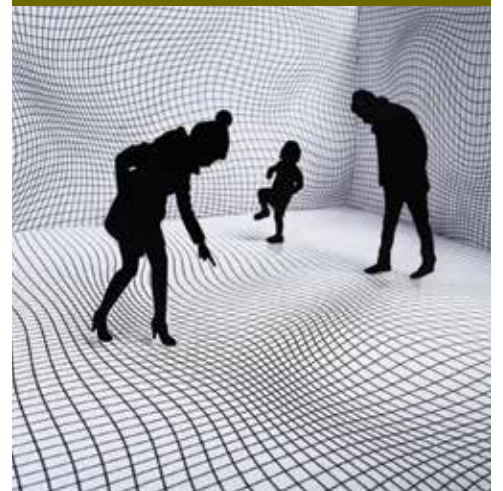
The new highly experiential exhibition *Our Senses: An Immersive Experience* delves into how our brains work with sensory organs to shape and reframe our perceptions of everyday encounters. And it reveals how, until recently in our evolutionary history, humans have been oblivious to nature's other crucial signals, including UV light and electrical fields.

Our senses are only part of the story, anyway. What we do sense is shaped by our brains into perceptions, often through an active process of knitting together information from sensory organs and filling in gaps from memories of past experience. Human brains are wired in part based on what helped our ancestors survive: noticing movement and paying attention to faces, for example. Other species' brains prioritize other signals: dolphins use more of their brains for hearing, because they navigate by sonar, and coyotes pay more attention to signals from their nose, since they depend on scent to find food. Visitors will be able to compare and rotate 3D images of the brains of a coyote, dolphin, and human.

Curator Rob DeSalle, whose recent exhibitions have included *Brain: The Inside Story* and *The Secret World Inside You*, curated this uniquely experiential exhibition, which features a virtual garden that visitors will explore through the eyes of a bee or a snake; an audio-collage challenging visitors to test their skill at tracking individual sounds; illusions that make flat surfaces appear rippled; and a section featuring a live presenter who will examine why our senses are essential to our survival, how the senses and world views of other species differ from ours, and what's truly unique about human perception.

Our Senses is generously supported by Dana and Virginia Randt.

MEMBER PREVIEW DAYS
FRIDAY, NOVEMBER 17
SATURDAY, NOVEMBER 18
SUNDAY, NOVEMBER 19
10:30 AM TO 4:30 PM



See *Our Senses: An Immersive Experience* before it opens to the public!

A weekend of exclusive Member Preview Days begins on Friday, November 17, for Members at the \$115 level and above.

Tickets are available starting November 1 by calling 212-769-5200.

TIMELY DISTINCTION

The Kawah Ijen sulfur pieces were the youngest specimens in the hall when it opened in 1999, just a year after the “birth” of the sulfur deposits. The oldest specimen in the hall was a zircon crystal from Australia, a portion of which is nearly 4.3 billion years old—or nearly as old as Earth itself.

WATCHFUL WAITING

Forecasting eruptions in Indonesia is critical, with more than 75 percent of its 260 million people living within range of an active volcano. Scientists routinely monitor for increases in water temperature in crater lakes and check the size and frequency of earthquake tremors, while satellites scan for land surface bulges caused by magma exerting pressure from below.

FATAL FAME

Indonesia is home to the volcano that triggered the “year without a summer” in 1816. On April 10, 1815, Mount Tambora erupted, resulting in massive local fatalities. The next year, untold numbers of people died or were displaced across Europe and North America when atmospheric conditions appear to have magnified a worldwide cooling trend that set off crop failures, famine, disease, and social upheaval.

SCIENCE AND ART

Mount Tambora’s 1816 eruption is recorded in sulfur-rich layers in ice cores extracted in Greenland and Antarctica. But its impact can also be seen in contemporary artwork. The vivid orange and red sunsets in landscapes by the 19th-century English painter J.M.W. Turner are thought to accurately reflect the residual effect on the color of the sky.

HARD HARVEST

Sulfur is prized for its many commercial uses, from vulcanizing rubber to refining sugar. Miners at Kawah Ijen hand-harvest the mineral, then trek out of the crater carrying their own weight—or more—in what is considered one of the most difficult and dangerous jobs in the world.

Seismic Sentinels

Stand in the Gottesman Hall of Planet Earth in front of the topographical bronze globe of Earth, and you can’t miss the two bright yellow forms a short distance just beyond and to the left. A quick scan of the display text reveals they are samples of sulfur from the Kawah Ijen volcano on the island of Java in Indonesia.

The sulfur column and slab were collected on June 8, 1998—the very day the sulfur solidified on the volcano—by a team led by geologist James Webster, curator in the Museum’s Department of Earth and Planetary Sciences. The trip was one of dozens of reconnaissance and acquisition expeditions undertaken from 1996 through 1999 in preparation for the opening of the hall on June 12, 1999, as Museum teams worked with experts around the world to identify geologically significant specimens to show the dynamic nature of Earth’s formation and ongoing existence.

The yellow sulfur forms after volatile gases—in this case, sulfur dioxide and hydrogen sulfide—are driven up by a volcano’s solidifying magma, flow to the surface, and escape from vents or fumaroles. It’s perhaps the best-known mineral to form in this way, although volcanic gases sometimes result in other minerals forming, such as silica and native gold.

Kawah Ijen is distinguished by a crater lake so intensely acidic, the water would eat through clothing and human flesh. Foul-smelling gases—think rotten eggs—vent from beneath the surface of the water, sometimes explosively in what’s called a phreatic eruption. But there are moments when the lake’s deep turquoise beauty can be enjoyed free and clear.

Says Webster, “It depends on how the wind blows.”



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Catalog no. 16/8802

Chiefly Chest

Earlier this year, Museum conservator Samantha Alderson took a cross-country journey to a remote archipelago off the coast of British Columbia, Canada. Her task? To accompany an elaborately carved and painted historic chest from the Museum’s collection back to its home nation for a celebration more than a century in the making.

The chest, which measures 63 inches across and 27 inches in height, had been carved sometime before 1880 by an ancestral holder of the title Gidansta, Chief of Skedans Village in the Haida Gwaii archipelago. It features an elaborate crest of a mountain goat and a moon on each of the broad sides, and grizzly bears on the ends. In 1901, the chest was sold to a collector named Charles Newcombe, who in turn sold it to the Museum the following year.

One hundred and sixteen years later, the chest returned to Haida Gwaii to play a role in a milestone event: two days of potlatch ceremonies honoring the memory of the most recent Gidansta and the inauguration of the name and title’s new holder. The chest’s use is a novel and creative model of collaboration, says Curator Peter Whiteley, who was also in attendance. “This loan represents a new kind of partnership between indigenous communities and major museums,” says Dr. Whiteley. “It’s particularly important given our ongoing collaboration with the Haida Nation, and our project to update installations in our historic Northwest Coast gallery in dialogue with First Nations representatives.”

The chest is now on display at the Haida Gwaii Museum at Kay Llnagaay, where it will be on view through spring 2018. “This important project continues to strengthen community pride, provide opportunities to observe and reflect on the legacies of historical and contemporary Haida art, and the strengthening of Haida culture and identity,” says Scott Marsden, director of the Haida Gwaii Museum. Before the chest travels back to New York next year, Gidansta’s sons—themselves accomplished carvers—plan to study it and create a replica that will remain in Haida Gwaii.

© AMNH/C. Chesek

WHERE IN THE WORLD

The Haida Gwaii archipelago includes about 150 individual islands located south of Alaska and north of Vancouver Island. Famous for its flora and fauna, Haida Gwaii is sometimes called “the Galapagos of the North.”

VILLAGE LIFE

The islands are home to two principal Haida villages, including Skidegate, where the Haida Gwaii Museum is located, and Old Massett, which is home to many artists. Old Massett features 17 contemporary totem poles, the largest concentration in Haida Gwaii.

ISLAND TO ISLAND

Joint efforts between Haida Gwaii and the Museum in the past few years have included a series of projects to bring the stories and perspectives of contemporary Northwest Coast people into the Museum’s historic Hall of Northwest Coast Indians. The new digital installation in the hall, which includes photos and interviews with people of the Pacific Northwest Coast, was created in collaboration with Northwest Coast community members.

GLIMPSE OF HAIDA GWAI

Via a telepresence robot in the Museum’s Hall of Northwest Coast Indians, Sean Young, an assistant curator at the Haida Gwaii Museum, connects to visitors in New York and offers views of his museum or interpretation of the Haida items on view in the hall.

Unlocking

New York's

Rocks

ASPIRING SCIENCE TEACHERS
IN MUSEUM'S GRADUATE
PROGRAM ARE TRACING
MANHATTAN'S GEOLOGY

*Instructor Nick Tailby, center, leads a group of
MAT candidates in Riverside Park.*

Ever wonder how teachers spend their summers?

For four of New York State's newest science teachers—Deborah Fishbeck, Donna Gangadeen, Aline Gjelaj, and Alejandro Mundo—last summer was dedicated to studying the rocks of Riverside Park. Specifically, they were looking for pieces to a geological puzzle: how a belt of rocks along the Hudson River, known as the Manhattan Prong, took shape hundreds of millions of years ago.

Their eight-week project, led by Museum geologists Nicholas Tailby, Curator George Harlow, and Curator Jim Webster, was a final requirement of the Museum's Master of Arts in Teaching (MAT) program. Heading into the last stretch of their 15-month program, the degree candidates had already spent one summer working with Museum scientists and education specialists, as well as a year in school residencies at partner New York State public schools. Now, they were coming to their final summer of fieldwork with a better view of how best to share science with students in the classroom.

They were also contributing to a multi-year effort to gather additional information about the ancient rocks of New York and their formation. Geologists know a lot about the structure of the Manhattan Prong—where the faults and folds are in relation to the local stress fields. But where the picture is less complete, if nonexistent, is the pressure and temperature path recorded in the rock belt, which would offer additional insights into the development of continental crust in New York.

To better probe these questions, this summer the MAT group collected samples in Riverside Park, then headed back to the lab to prepare them into polished slices—some as thin as 30 microns—for analysis under an electron microscope or CT scanner at the Museum. "It's not easy to do in eight weeks," says Dr. Tailby. "Prepping samples, analyzing minerals, crunching the numbers. We really push them hard." (Others in the cohort spent the summer working on projects with an astronomer and a geochemist.) The geology group's work added to research conducted by other MAT candidates in Central Park last summer, and another MAT group will explore an area of the Bronx in summer 2018.

"The ultimate goal is to produce science we can publish on the geologic history of the Manhattan Prong," says Tailby. In the meantime, each summer of fieldwork has had immediate results as well. Each group produces an in-depth field guide to use as a starting point for field trips with middle- and high-school students, and shares the guides with the New York State Park Service, which approves the research in the parks and grants the permission to take samples. "We want to demonstrate we are doing science and contributing to the broader community," says Tailby.

And for the teachers about to enter classrooms in New York State's high-needs middle and high schools, capping the pedagogical experience with an intensive summer of research offered a powerful toolkit to bring back to the classroom. "It's a lot more meaningful to learn about rocks in the field rather than look at a single rock specimen, which is disconnected from the bigger picture," says Fishbeck, who graduated with her class of 15 in September and is now teaching at the Bronx Center for Science and Mathematics.

Adds her classmate Mundo, who is now teaching at Kingsbridge International High School in the Bronx, "Before, as a geologist, I'd see the outcrop. But now I ask myself, 'How can I get my students to see it as I see it?'"

With deepest appreciation, the Museum acknowledges Kathryn W. Davis for her generous founding support of the Master of Arts in Science Teaching (MAT) Program. Leadership support for the MAT program is provided by The Shelby Cullom Davis Charitable Fund.

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Rotunda / Fall 2017 / AMNH.org



MUSEUM'S
MAT
PROGRAM
VITAL STATS

5

Classes graduated
since 2013

8,400

Students in New
York State being
taught by program
graduates

70

Alumni teaching
in high-needs
schools in New
York State

100%

Job placement
for graduates

OUR SENSES:
AN IMMERSIVE
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MORE THAN MEETS

THE EYE

Scientists are **EXPERTS** at observing the world around us. But sometimes, that means recognizing the **LIMITATIONS** of our senses—and **PUSHING** beyond them.

W

hether it's listening to your dinner date at a busy bistro or reading right through "Showtime!" on the subway, New Yorkers—and humans in general—tend to be pretty good at focusing their attention and filtering out the noise. That sort of selectiveness is important to scientists as well. When studying the depths of the ocean or the reaches of outer space, Museum researchers are developing tools that help us shut out some of the data—and make it possible to discover things we never expected.

SHOCKING PINKS...AND GREENS, AND ORANGES

Beneath the surface of the ocean, everything looks blue. That's because once you're 20 to 30 meters down, ocean water absorbs other colors of light—oranges, greens, reds, and yellows—and leaves the world cyan-hued—to us, that is. It turns out, we're seeing blue because we're looking at the underwater world through the eyes of land lubbers.

To natives of the seas, that world looks very, very different. It's highlighted with biofluorescent light emitted by all kinds of fishes, corals, anemones, and even sea turtles. Molecules present in these organisms absorb the high-energy, blue-tinged sunlight that filters down to them and re-emit it in vibrant displays of orange, red, green, and yellow.

While these lightshows are technically visible to the human eye, they get lost in the ambient light of the Sun. That means they have been largely unseen—and unstudied—by scientists, until recently. Curator John

Sparks and his colleagues have been developing new ways to keep out some wavelengths of light and better visualize these dazzling displays, and in 2014 they identified more than 180 species of biofluorescent species of fishes across 16 orders. In recent years, they've learned that turtles glow underwater, too.

Now, Sparks and team are refining specialized lights, lenses, camera housings, and filters to make it easier for researchers to better understand biofluorescence in marine organisms.

WHAT THE FISH SAW

To get a look at biofluorescence in action, Sparks and collaborators, including Yale neuroscientist Vincent Pieribone and Museum Research Associate David Gruber, try to get a fish-eye view.

How? By designing their equipment—including camera filters, which were developed specifically for underwater research—to see like a fish. The team can dissect the eyes of a fish specimen to learn which spectra of light a particular species can see underwater, then use that information to create filters that mimic that absorption spectra. The result is gear that lets the team experience the world the same way their research subjects do.

"Using these 'fish-eye' cameras, we can begin to better understand what other organisms see under water," says Sparks.

"That has let us learn how catsharks, for example, can enhance their ability to communicate by producing green biofluorescent light. Light at these wavelengths is visible to other catsharks, but is otherwise filtered out at these depths."

Studying marine life requires developing new ways, and new tools, to see underwater.

PERFECT DARK

Sparks also studies underwater bioluminescence, in which organisms don't require energizing blue light to make themselves seen. Instead, they produce light via chemical reactions—similar to the ones you can see every summer in the flicker of a firefly's glowing abdomen.

Just as fireflies use their lights to communicate, some species of fishes and other marine organisms appear to use their bioluminescence to gain some advantage in the dark. Sparks and colleagues are researching this phenomenon. One factor that may be key to learning more about how fishes signal, hunt, and otherwise interact with one another using light is keeping those observations undetected. Dropping a shining LED into the midst of fishes that flash light signals at one another is, after all, pretty disruptive.

Using FISH-EYE CAMERAS, we can begin to BETTER UNDERSTAND what other organisms see UNDERWATER.

The current generation of deep-sea remotely operated vehicles—or ROVs, robots that scour the sea bottom for data—depends on some old-school tools to watch fishes under water: noisy motors, bright lights, and inelegant robotic grabbing arms. Even traditional nets can create pressure waves that disrupt delicate underwater ecosystems. That's why Sparks and his colleagues are developing and using new tools to make the studies they conduct less noticeable to their subjects, including cameras that can shoot in ultra-low light.

"Using modern ultra-low-light cameras, you can film at night 200 meters below the surface of the ocean, and the small amount of light emitted from

bioluminescent organisms can make it look like broad daylight," says Sparks.

BLINDED BY THE LIGHT

Biologists studying the deep ocean aren't the only ones working in the dark. So are astronomers, who depend on interpreting the light from distant objects to study the universe. But sometimes, that same light can also get in the way, preventing scientists from seeing everything that's out there.

Since 1995, Curator Rebecca Oppenheimer in the Department of Astrophysics has been working with colleagues on new astronomical instruments to develop an advanced tool that filters starlight from telescope images. By turning down the brightness of nearby stars, the technique, called a coronagraph, makes it possible for researchers to directly observe faint celestial objects orbiting nearby stars.

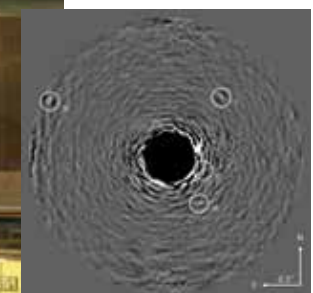
"In 1995, we used a primitive coronagraph, now exhibited in the Cullman Hall of the Universe, to discover and study the first brown dwarf, an object intermediate between planets and stars," Oppenheimer says. "Since then we have built three new, far more advanced coronagraphs in the astrophysics lab here at the Museum and actually conducted some of the first reconnaissance of nearby solar systems quite different from our own.

The early coronagraph on view at the Museum isn't just an artifact of space exploration. It's an early product of the research and development that took place only a few flights up from where it's now exhibited. Much of the technology was produced by Oppenheimer and her team, then taken into the field for detailed studies of the atmospheres and orbits of alien solar systems—revealing parts of our universe previously hidden from us by the glare of other stars. ☾

Previous spread: D. Gruber. This page: © K. McBurnie. Opposite page: Courtesy R. Oppenheimer



To improve their view of the universe, astronomers are using new tools to filter out starlight.



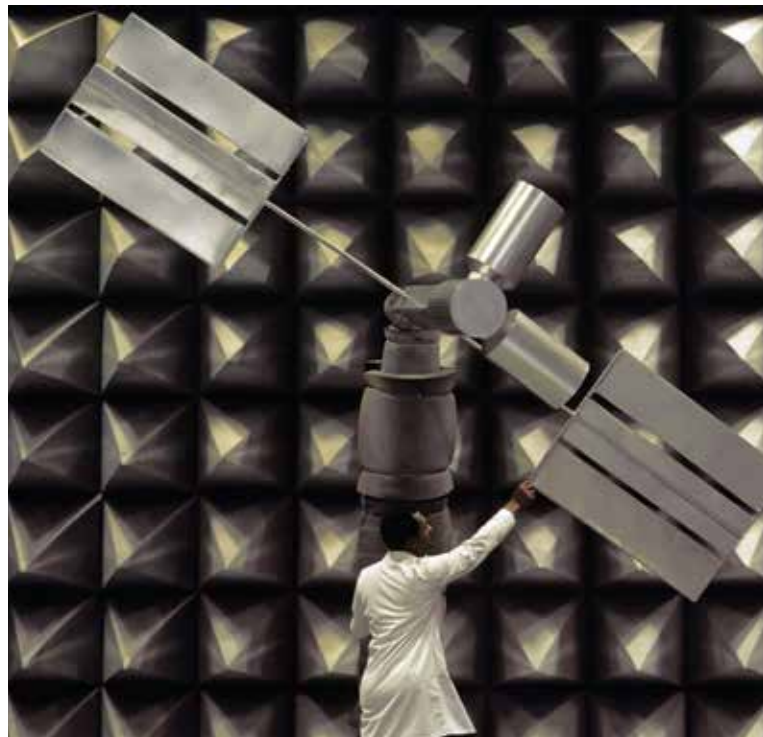
THE SOUND OF SILENCE

HOW EARTH'S QUIETEST PLACES HELP US BETTER UNDERSTAND OUR SENSES

What do you think of when you think of quiet? A night camping in the woods, away from the bustle of the city? Or maybe a library reading room?

Trust us—you haven't heard quiet yet. To truly escape sound, there's just one option: enter an anechoic chamber.

Initially developed for testing audio equipment, these "no-echo" chambers are like sound studios on steroids. They're typically housed in double-walled rooms surrounded by thick layers of concrete or brick, then lined with insulation to absorb every trace of sound. They're so quiet, in fact, that NASA tests equipment—including antennas, pictured below and right—and trains astronauts for space flight in chambers like these—the closest simulation of silent space found on Earth.



CATCHING WAVES

Our ears pick up sound waves as they bounce off our surroundings. Anechoic chambers are designed to catch and mute those reflections with walls made of wave-suppressing foam or fiberglass wedges.

SPRINGS ETERNAL

Many anechoic chambers are supported by springs rather than traditional foundations, preventing vibrations from affecting the space.

SOUNDS OF SELF

Visitors to these super-silent rooms become aware of things they can't usually hear, like their own breathing and even their heartbeat, and human voices sound clipped without the reverberation in the room around them.

LOST IN SPACE

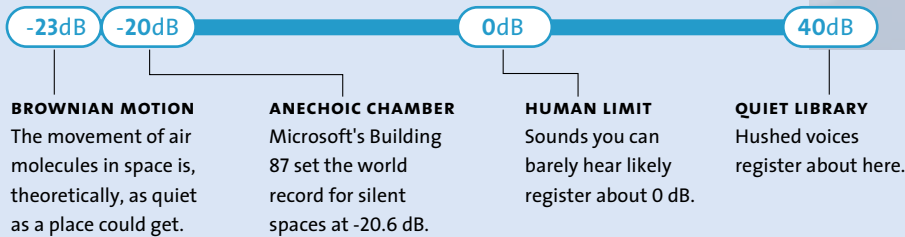
Sound is an important part of how humans navigate a space, and without the the perceptual cues provided by echoes, many people will find their sense of balance disrupted. Some who use anechoic chambers even report difficulty standing up, and technicians recommend a chair for anyone spending more than 30 minutes here.

MESH PIT

The floor of an anechoic chamber is often a mesh of cables or wires suspended over yet more sound-suppressing foam wedges.

HOW QUIET IS AN ANECHOIC CHAMBER?

Compared to an anechoic chamber, even a whispered secret is more like a shout than a murmur. Here's how anechoic chambers stack up in the sound department, decibel by decibel.



You won't find an anechoic chamber in **OUR SENSES: AN IMMERSIVE EXPERIENCE**, but you'll be able to explore 11 galleries that test your perceptions. As always, Members can see the new exhibition before it opens to the public when Member Preview Days begin on November 17. For more details, see page 3.

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 September 1. Please check amnh.org/calendar for updates.

OCTOBER

SciCafe: Humans and Conflicts with Bears: Oh My!
Wednesday, October 4
7 pm

Free for 21+ with ID
Conservation scientist **Rae Wynn-Grant** offers insights into black bear behavior and ecology and shares tips on what humans can do to improve relations with our ursine neighbors.

Rhoda and the Fossil Hunt: A Site-Specific Opera for Families

Fridays, Saturdays, Sundays,
October 6–15
See amnh.org for times
Free for Members

Join Rhoda as she hunts for missing fossils in the Hall of Saurischian Dinosaurs in this site-specific opera with music by John Musto and libretto by Eric Einhorn, based on the real-life experiences of Rhoda Knight and her naturalist-illustrator grandfather Charles R. Knight.

Endurance with Astronaut Scott Kelly
Monday, October 16
7:30 pm
\$12

Hayden Planetarium Space Theater
Join astronaut **Scott Kelly**—a veteran of four spaceflights who has spent more consecutive time in space than any other American—and Frederick P. Rose Director of the Hayden Planetarium **Neil deGrasse Tyson** for a conversation all about the extreme challenge of long-term spaceflight.

A book signing will follow.



2017 Margaret Mead Film Festival: Activate
Thursday, October 19–
Sunday, October 22
Screenings: \$10
Opening Night: \$12

Activate a connection to your community and others around the world at the 2017 Margaret Mead Film Festival, featuring more than 40 ground-breaking nonfiction films and stories from around the world, a new Mead Mixed Media Lounge, and opportunities for filmmakers, scholars, and audiences to mingle and exchange ideas.

Tickets and film listings available at amnh.org.

Field Trip to the Moon
Friday, October 20

6–6:30 pm, 6:45–7:15 pm
\$12.50 adults, \$8 children

Join us for a virtual trip to the Moon in the immersive Hayden Planetarium. Feel the ground shake beneath you as you experience a thrilling NASA rocket launch. Take a guided tour of the cosmos and orbit the Earth to get an astronaut's view of a sunrise in space!

Exhibitions

Admission is by timed entry only.

Our Senses: An Immersive Experience
Free for Members

We get to know our world through some or all of our senses—sight, smell, hearing, touch, balance, and taste—but they're just parts of a much larger puzzle. This highly experiential exhibition delves into how our brains work with sensory organs to shape our perceptions.



OPENS SOON

Mummies

Free for Members

Discover when, how, and why ancient Egyptians and Peruvians were mummified, and find out who they were in life. This show features rarely exhibited mummies, as well as interactive touch tables, rare artifacts, and cutting-edge imaging.



CLOSES 1/7

Roosevelt Island with Sidney Horenstein
Saturday, October 21
10 am–noon
\$25

Join us for a Members-only walking tour of Roosevelt Island with geologist **Sidney Horenstein**. Take in the breathtaking sights of Four Freedoms Park and learn about the history and geology of Roosevelt Island.

Birding at Green-Wood Cemetery

Saturday, October 28
10 am–noon
\$25

On the weekend before Halloween, take in the splendor of the Gothic-style tombs at Green-Wood Cemetery and experience the exciting colors and sounds of the fall migration with **Paul Sweet**, collections manager of the Museum's Ornithology Department. Green-Wood Cemetery hosts a colony of Monk Parakeets and is also an ideal place to observe migrating birds.

This tour is appropriate for participants ages 14 and up. Children must be accompanied by an adult.

Family Halloween Celebration
Saturday, October 28
2–6 pm
See amnh.org for ticket information

More than 50 of the Museum's popular halls will be open for trick-or-treating, arts and crafts, fun with roaming cartoon characters, and live performances.

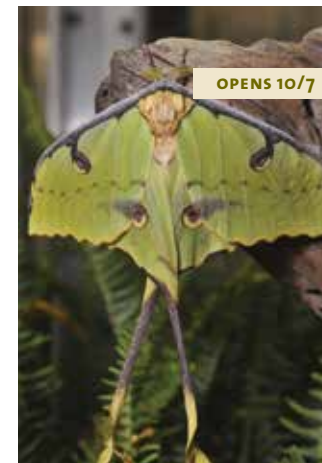


Hall Tour: Finding Fossils
Sunday, October 29
1:30 pm

Free
Registration required; call 212-769-5200
Join a Museum tour guide on an expedition through the world's largest and most diverse collection of vertebrate fossils to learn more about famous Museum explorers. Gain a deeper understanding of how fossils are found, excavated, and analyzed by scientists to uncover new and exciting discoveries.

The Butterfly Conservatory

This annual favorite returns with up to 500 free-flying tropical butterflies from the Americas, Africa, and Asia. Find featured species such as iridescent blue morpho butterflies, striking scarlet swallowtails, and large owl butterflies.



OPENS 10/7



Astronomy Live: Spooky Astronomy

Tuesday, October 31
\$12

Hayden Planetarium Space Theater
On Halloween night, join **Jackie Faherty** and **Lydia Maria Petrosino** for spooky stories of the cosmos. Come in your most "Out of this World" costume and receive a special giveaway.

Recommended for children ages 12 and up.

NOVEMBER

SciCafe: Are We Alone in the Universe?
Wednesday, November 1
7 pm

Free for 21+ with ID
Lisa Kaltenegger explores how we can use our own planet and its wide range of biota as a Rosetta Stone to detect signs of life on exoplanets over vast interstellar distances to answer the question—*are we alone in the universe?*

Take Flight: An Evening Bat Encounter and Reception
Friday, November 3
6:30–8 pm

\$35 for 21+ with ID
Join us for a Members-only Evening Bat Encounter with **Rob Mies**, executive director of the Organization for Bat Conservation. Learn more about the vital roles these creatures play as pollinators of some of our favorite plants, including the *Agave tequilana*. See bats from around the world and enjoy a cocktail with renowned Museum scientists!



Inside You

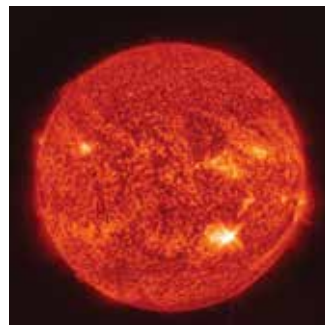
Inspired by the Museum's popular exhibition *The Secret World Inside You*, this new exhibition in the Akeley Gallery introduces visitors to microbes that live in, on, and around all of us.



Family Astronomy: Achakosuk (the Stars)
Saturday, November 4
6:30 pm
 Hayden Planetarium Space Theater
\$10 Members
 Join us for an evening in the Hayden Planetarium with “The Star Guy” **Wilfred Buck**, who will share the legends and stories collected from the Cree, Ojibwe, and Dakota First Nations. Learn how indigenous people from the First Nations have connected to the sky for thousands of years.

Animal Encounter: Bats with Rob Mies
Saturday, November 4
11 am (recommended for younger children), **1:30 pm, 3 pm** (all ages welcome)
\$15

Get an up-close and personal introduction to bats from around the world! Conservation biologist and bat expert **Rob Mies** will host this unforgettable presentation with many species of bats, including a Rodrigues fruit bat, a straw-colored fruit bat, a big brown bat, and a Malayan flying fox.



Recommended for children ages 4–11.



Temblor Tales: Detecting Quakes in Cascadia
Wednesday, November 8
6:30 pm
Free

Registration required; call 212-769-5200
 The sudden and severe impact of earthquakes makes them feared worldwide. In the Pacific Northwest, several kinds of quakes threaten, including rips that could tear Seattle’s downtown apart. Seismologist **John Vidale** explains how new technologies may allow scientists to detect quakes minutes before the strongest shaking hits.

Hall Tour: Climbing the Tree of Life
Saturday, November 11
10:30 am (recommended for families with children)
1:30 pm
Free
Registration required; call 212-769-5200
 Join a Museum tour guide in the Gottesman Hall of Planet Earth and the Spitzer Hall of Human Origins to examine how humans fit into the remarkable biodiversity of life on Earth. Take a closer look at some of our closest and most distant relatives to better understand our place within the tree of life.

Frontiers Lecture: The Zoomable Universe
Monday, November 13
7:30 pm
\$12

Inspired by the best-selling book and classic film *Powers of Ten*, the award-winning astrobiologist **Caleb Scharf** takes you on an epic tour through all known scales of reality, from the largest possible magnitude to the smallest.

A book signing will follow.

Earthflight

Narrated by Academy Award-winning actress Cate Blanchett, **Earthflight** takes viewers on incredible flights to discover the fascinating science of flight: how birds maneuver simultaneously in flocks a million strong, navigate across whole continents, and collaborate with other animals to find food.

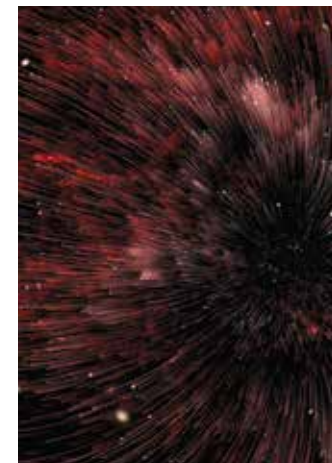
Captioning devices are available.



Dark Universe

Narrated by Neil deGrasse Tyson, 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.



DECEMBER

Hall Tour: Hidden Stories
Saturday, December 2
10:30 am (recommended for families with children)
1:30 pm
Free

Registration required; call 212-769-5200
 Join a tour guide to learn how the Museum acquired some of its rarest and most beloved treasures. Travel back in time and across the globe with some of your favorite explorers to uncover the Museum’s rich and storied history.

This tour is appropriate for participants ages 12 and up.

Double Discount Days
Sunday, December 3–
Saturday, December 9

Get out in front of holiday shopping with twice your regular Member discount! For a week in December, Members save 20 percent on purchases in the Museum’s retail shops and online store. Just have your membership card handy at checkout.

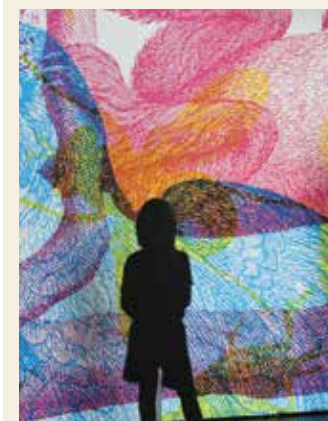


Astronomy Live: “Voyagers”
Tuesday, November 28
7 pm
\$12

In celebration of the 40th anniversary of the Voyager spacecraft, composer **Gerald Cohen** brings us *Voyagers*, a new musical piece for clarinet and string quartet. The program features the **Cassatt Quartet** and clarinetist **Vasko Dukovski** accompanied by visualizations designed by Director of Astrovisualization **Carter Emmart**. **Timothy Ferris**, producer of Voyager’s Golden Record, joins as a special guest.

Double Discount Days
Monday, November 13–
Sunday, November 19

Get out in front of holiday shopping with twice your regular Member discount! For a week in November, Members save 20 percent on purchases in the Museum’s retail shops and online store. Just have your membership card handy at checkout.



Member Preview Days: Our Senses

Friday, November 17
Saturday, November 18
Sunday, November 19
10:30 am–4:30 pm
Free for Members at the \$115 level and above.
 Tickets available starting November 1; call 212-279-5200.

Exhibition Credits

Our Senses is generously supported by Dana and Virginia Randt.

Mummies was developed by The Field Museum, Chicago.

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

Mummies is proudly supported by Chase Private Client.

Generous support for The Butterfly Conservatory has been provided by the Eileen P. Bernard Exhibition Fund.

Inside You is made possible by the generosity of the Arthur Ross Foundation.

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

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.

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.

The Neuroscience of Illusion
Tuesday, December 5
 7 pm
 \$12

Seeing is believing—or is it? Our brains perceive the world through our senses, and those senses can be fooled. That creates a gap between perception and reality—a place where we find magic. Join master illusionist **Apollo Robbins** and neuroscientists **Stephen Macknik** and **Susana Martinez-Condeas** we explore the limits of our own visual perception and learn the scientific secrets behind some of magic’s greatest tricks.

SciCafe: Biodiversity and the Sixth Extinction
Wednesday, December 6
 7 pm

Free for 21+ with ID
 Earth is losing biological diversity at an unprecedented rate. Could this lead to the collapse of Earth’s habitats and ecosystems? What might that mean for humanity? Lamont Curator **Joel Cracraft** presents the evidence, drawing from his experiences in Earth’s tropical forests, and outlines the difficult challenges ahead.

Milstein Science Series: Celebrating Cephalopods
Sunday, December 10
 11 am–4 pm

Milstein Hall of Ocean Life
 Free
 Cephalopods such as octopuses and squids have fascinated human beings for millenia. Learn more about these marine marvels through performances, presentations, and live animal encounters at this family-friendly festival.



Frontiers Lecture: Demystifying Black Holes
Monday, December 11
 7:30 pm
 \$12

Hayden Planetarium Space Theater
 Black holes are both astrophysical phenomena and theoretical “laboratories.” From gravitational radiation to X-ray binary star systems, **Steven Gubser** and **Frans Pretorius** use creative thought experiments to explain the fantastical properties of black holes.

A book signing will follow.

Winter Solstice Telescope Party
Wednesday, December 20
 7 pm
 \$12

Hayden Planetarium Space Theater
 Join Museum astronomers and members of the Amateur Astronomers Association on the longest night of the year. Pick up pointers on how best to observe the night sky and get a “sneak preview” of what it will look like from the Space Theater. Then, weather permitting, we’ll head outside to the Ross Terrace to observe celestial objects.

Astronomy Live: Astronomical Calendar
Tuesday, December 26
 7 pm
 \$12

Hayden Planetarium Space Theater
 Prepare for your next journey around the Sun as **Ted Williams** and **Irene Pease** share the highlights of 2018, including celestial sights and constellations from January to December.



Save the Date! KWANZAA 2017
Saturday, December 30
 Free

Join us for a celebration of African-American heritage rooted in seven principles known as Nguzo Saba, which promote unity, culture, and community development. The program will feature a live musical performance, an overview of the Kwanzaa principles, and a marketplace that showcases local artisans from the African-American community.

© C. Cheseck, D. Firmin, R. Mickens, and M. Shanley with the exception of Scott Kelly and Moon (NASA), Mummies (© 2015 The Field Museum, A15218d_003C, photographer John Weinstern), Earthlight (photo by Christian Moulic © John Downer Productions), Seattle earthquake (University of California Berkeley), Cassatt Quartet (A. Ablogina)

Program Credits

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

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

Family Halloween Celebration is made possible with support of The Rudin Foundation, Inc.

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 Annual IRIS/SSA Lecture Series is presented in collaboration with the Incorporated Research Institutions for Seismology and the Seismological Society of America.

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

The Margaret Mead Film Festival is made possible with the support of Governor Andrew M. Cuomo and the New York State Legislature.

Support for the Margaret Mead Film Festival and Kwanzaa 2017 is provided, in part, by the May and Samuel Rudin Family Foundation, Inc. and the family of Frederick H. Leonhardt.

OCTOBER

4 WEDNESDAY
 SciCafe: Humans and Conflicts with Bears: Oh My!
 After-Hours Program

6 FRIDAY
 Rhoda and the Fossil Hunt (performances through October 15)
 Family Program

7 SATURDAY
 The Butterfly Conservatory returns to view

16 MONDAY
 Endurance with Astronaut Scott Kelly
 Hayden Planetarium Program

19 THURSDAY
 Margaret Mead Film Festival begins

20 FRIDAY
 Field Trip to the Moon
 Member Program

21 SATURDAY
 Roosevelt Island with Sidney Horenstein
 Member Program

28 SATURDAY
 Birding at Green-Wood Cemetery
 Member Program

Family Halloween Celebration
 Special Program

29 SUNDAY
 Hall Tour: Finding Fossils
 Member Program

31 TUESDAY
 Spooky Astronomy
 Hayden Planetarium Program

NOVEMBER

1 WEDNESDAY
 SciCafe: Are We Alone in the Universe?
 After-Hours Program

3 FRIDAY
 Take Flight: An Evening Bat Encounter and Reception!
 Member Program

4 SATURDAY
 Animal Encounter; Bats with Rob Mies
 Member Program

Family Astronomy: Achakosuk (the Stars)
 Hayden Planetarium Program

8 WEDNESDAY
 Temblor Tales: Detecting Quakes in Cascadia
 Lecture

11 SATURDAY
 Hall Tour: Climbing the Tree of Life
 Member Program

13 MONDAY
 The Zoomable Universe
 Hayden Planetarium Program

Double Discount Days begin

17 FRIDAY
 Our Senses: An Immersive Experience
 Member Preview Days begin

20 MONDAY
 The Senses: Our Windows to the World begins
 Adult Course

Origami Holiday Tree goes on view

28 TUESDAY
 Voyagers
 Hayden Planetarium Program

DECEMBER

2 SATURDAY
 Hall Tour: Hidden Stories
 Member Program

3 SUNDAY
 Double Discount Days begin

5 TUESDAY
 The Neuroscience of Illusion
 Special Program

6 WEDNESDAY
 SciCafe: Biodiversity and the Sixth Extinction
 After-Hours Program

10 SUNDAY
 Milstein Science Series: Celebrating Cephalopods
 Family Festival

11 MONDAY
 Demystifying Black Holes
 Hayden Planetarium Program

20 WEDNESDAY
 Winter Solstice Telescope Party
 Hayden Planetarium Program

26 TUESDAY
 Astronomical Calendar
 Hayden Planetarium Program

30 SATURDAY
 Kwanzaa 2017
 Family festival

2017 By the Numbers

Not all the work the Museum does can be measured—you can't put a number to the look of wonder when a child sees *T. rex* or The Titanosaur for the first time.

But there are some numbers that help quantify the discoveries made possible, the learning facilitated, and the many other contributions made to science and to sharing scientific knowledge that were made this year.

And none of these milestones would be possible without the support of our Members. So let's count the ways you helped make the world a little more enlightened this year.



16 NEW GRADUATES

In September, the Museum's Richard Gilder Graduate School celebrated 2017 graduates, including 3 doctoral graduates and 13 M.A. in Teaching graduates, who began teaching in New York State middle and high school classrooms this fall.

2 MILLION+ VIEWS

Our Facebook followers around the world have been tuning in to go behind the scenes in Museum collections with scientists, tour exhibitions with curators, and even find out what it takes to dust the *Barosaurus*.



SPECIMEN 223

The first-ever dinosaur fossil excavated by Museum paleontologists finally got its collections number this summer. The fossil femur, from *Diplodocus*, is now on display alongside The Titanosaur in the Miriam & Ira D. Wallach Orientation Center and on view 363 days of the year.



14 TRAVELING EXHIBITIONS



After opening in New York, the Museum's exhibitions keep going, and going. Last year, they went on display in 24 venues in 3 countries.

19 MUMMIES



From the collections of The Field Museum, these rarely seen specimens—among the best-preserved mummies in the world—revealed to visitors what scientists are learning about ancient cultures thanks to new technologies.

4,000+ TEACHERS

Thousands of teachers turned to the Museum this year for professional development, onsite and online.

Photos © AMNH/C. Chesek, D. Finnin, and R. Mickens except Mummies © 2015 The Field Museum; A15244L_016B; photographer John Weinstein and brown dwarf (NASA).

1 BROWN DWARF



This distant celestial object—over 100 million light years away from the Earth—was discovered in February by citizen scientists working with Backyard Worlds: Planet 9, an online sky survey led by a team that includes a Museum astronomer.

HELP MAKE 2018 EVEN BETTER

Each of our Members plays a vital role in helping advance the Museum's work in science and education. You can do even more by making a tax-deductible gift to the Museum's Annual Fund at amnh.org/annualfund.

Origami Menagerie

The Museum's Origami Holiday Tree returns November 20

Planning for the Origami Holiday Tree, which returns to the Museum after Thanksgiving, has been underway for months. It's a marathon, not a sprint—and it has to be, to give the volunteers from OrigamiUSA time to plan and create hand-folded models that decorate it every year.

Just like the Museum's halls, the Origami Tree is home to reliable favorites and special attractions alike. Origami models of Museum stalwarts like *T. rex* are perennial favorites that grace the tree every year, and some of the greatest hits date to the very beginning of the Museum's tree-trimming tradition. One origami pterosaur, for instance, goes all the way back to the 1970s.

But each year, these are joined by new models that reflect what's happening at the Museum today. Last year, for instance, The Titanosaur got an origami model of its own—a sure sign that the new Museum icon had arrived.

While models of Museum specimens like dinosaur fossils and animals from the dioramas are popular ones to spot, that's not to say that the Department of Astrophysics is unrepresented—after all, what's a holiday tree without the star? The Museum's tree goes above and beyond, with 50 mobiles, each made up of multiple stars.

What will you see on the tree this year? You'll have to come by to find out! The Origami Holiday Tree goes on view November 20.

If you need your folding fix before that, we've got you covered. Follow the instructions below to fold the last page of this issue into an origami model of your own. We picked—what else?—the blue whale.



AMNH/ D. Firmin and R. Mickens

ORIGAMI 101

VALLEY FOLD

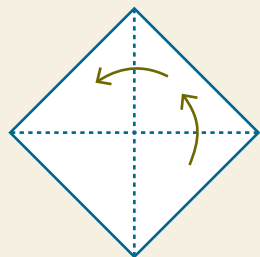
A fold that creates a valley in the paper—think a hot dog bun.

MOUNTAIN FOLD

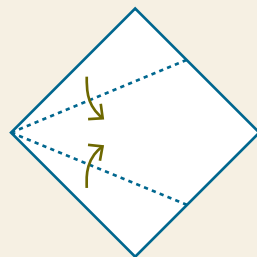
A fold that leaves the paper standing up like a mountain.



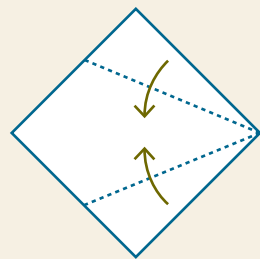
KNOW HOW TO FOLD 'EM: WHALE



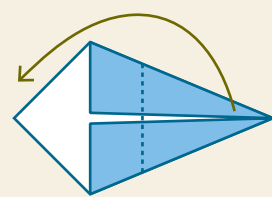
1. Start with a square, white side (back of the magazine) up. Pre-crease along diagonals as marked



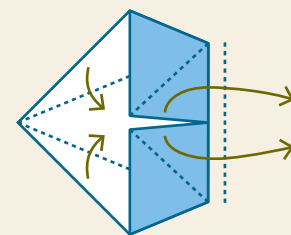
2. Fold the sides in half, to the center, then unfold.



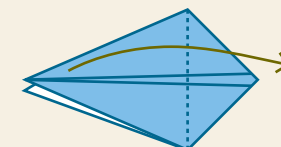
3. Flip the square and fold the sides in half.



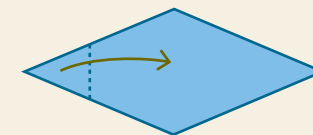
4. Fold length-wise, so that bottom point meets the top point.



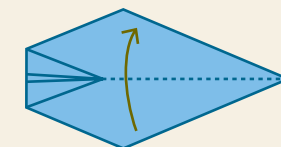
5. Pull the corners to the right, allowing edges to lie against the center.



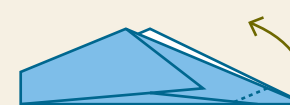
6. Valley fold the top flap over.



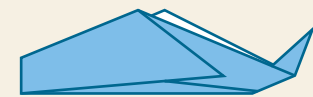
7. Valley fold the flap over.



8. Valley fold the model in half.



9. Reverse fold the right point upwards.



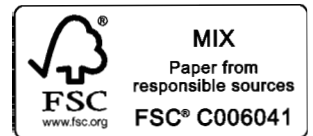
10. Your whale should be done!

NEED SOME HELP?

OrigamiUSA volunteers will be on hand when the Origami Holiday Tree goes on view.

Diagram courtesy of origami.org.

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



Animalia n.1 by Camovsky, 2010



Test your perceptions in the new exhibition *Our Senses: An Immersive Experience*, opening this November. Members see it first. Find out more about the exhibition and Member Preview Days on page 3.

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, 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,
Senses Shop, Mummies 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.