

150 YEARS

AMERICAN MUSEUM OF NATURAL HISTORY

ROTUNDA

Member Magazine
Winter 2020 Vol. 45 No. 1

GREENHOUSE WORLD

The
Nature
of
Color

From the President

Ellen V. Futter



Space science has long been an iconic and beloved part of the Museum, so it is fitting that the Museum's 150th anniversary celebrations include an unprecedented journey beyond planet Earth.

In January 2020, the Rose Center for Earth and Space will premiere *Worlds Beyond Earth*, a dazzling new Hayden Planetarium Space Show, taking viewers on an adventure through our own extraordinary solar system, from our planetary cousins Mars and Venus, to the asteroid belt, to gas giants like Saturn and Jupiter, to some of the nearly 200 moons orbiting the planets. The Space Show will also highlight advances in robotic exploration over the past 50 years, which have yielded many surprising discoveries about the nature of our solar system neighbors, as well as a deeper understanding of the uniqueness of our home planet.

Narrated by Academy Award winner Lupita Nyong'o, *Worlds Beyond Earth* will be brought

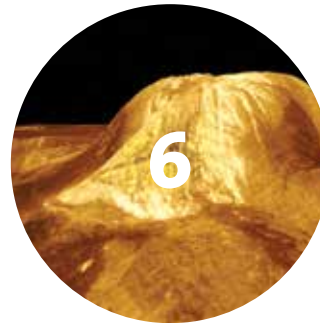
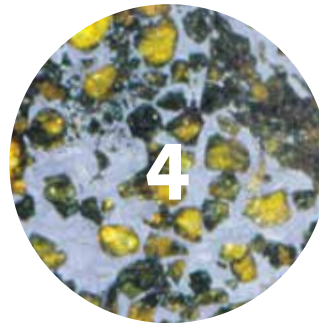
to dazzling life by a brand-new High-Dynamic-Range (HDR) projection system installed in the Hayden Planetarium last year. This first-of-its-kind system displays the greatest color gamut of any planetarium in the world, allowing visitors to experience both the darkness of space and the brightness of its colorful worlds in ways never previously possible. So prepare to be amazed!

Worlds Beyond Earth is dedicated to the memory of Charles Hayden on the 150th anniversary of his birth year. Charles Hayden's generosity made possible the creation of the original Hayden Planetarium, and his family foundation has continued to support the Planetarium and its astronomy programs in the Rose Center to this day.

We hope you will explore *Worlds Beyond Earth* with us, as we continue to celebrate both our 150th anniversary and the unending thrill of scientific discovery.

Table of Contents

Close-Up	4
The Toxic Twin	6
Power Colors	10
The Planetarium's Patron	12
Next	14
Marine Life on the Mezzanine	20
The Stars Above	22



ROTUNDA

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Museum Research Library Launches Major Archival Initiative



Special Collections Archivist Becca Morgan and Library Director Tom Baione pictured with zoologist Libbie Hyman's typewriter and other objects.

Roy Andrew Chapman's 1925 Mongolian passport. A wax cylinder recording device from the late 19th century. The planning notes for a visit to the Museum by Marie Curie in April, 1921. Is there anything that transports us to a time and place like a physical object?

As the Museum celebrates its 150th anniversary, the Research Library is working to make these and other items in the Museum's vast collection of archival treasures more accessible to the public and researchers through the new Shelby White and Leon Levy Archive Initiative. The three-year project will help expand access to the central archive documenting the Museum's first 100 years, to create a comprehensive digital asset management system for digitized papers, images, videos, and other digital materials, and to reorganize thousands of items in the Memorabilia Collection.

"These are materials created for a specific purpose that help us tell the story of the Museum through objects," says Tom Baione, Harold Boeschstein Director of the Museum's Department of Library Services. "The Shelby White and Leon

Levy Archive Initiative supports efforts to enhance access to archival materials, reveal the richness of the collections, and create a framework for future growth."

The Central Administrative Archive is the Museum's largest archival collection and repository of the internal and external correspondence, regarding everything from field expeditions to acquisitions to the letters of Museum scientists and administrators, and notes from the public, including Franklin Delano Roosevelt, age 13, inquiring after his membership card. The contents will be re-assessed and comprehensively indexed for easier retrieval. The new digital asset management system will expand on the Museum's ongoing efforts to digitize scholarly assets and make them available online. The Memorabilia Collection, in addition to being reorganized for increased access, will be stored in new compact shelving to increase capacity. And, looking ahead, a selection of memorabilia will be displayed on a glass-shelved wall in a new public area of the Library that will open with the Richard Gilder Center for Science, Education, and Innovation.

Save the Dates: Member Preview Days for *Worlds Beyond Earth* and *The Nature of Color*

One of the benefits of Membership is the opportunity to see new special exhibitions and Space Shows before they open to the public. In the next few months, Members will have the chance to attend two exciting previews.

From January 18 through 20, Members can get a first look at the new Space Show, *Worlds Beyond Earth*. Narrated by Academy Award

winner Lupita Nyong'o, it takes viewers on a sweeping journey around our solar neighborhood.

From March 6 through 8, be the first to see *The Nature of Color*, an immersive exhibition for all ages.

For more details, see p. 14 and p. 18.

D. Finnin/© AMNH

MISSING METEORITES

Earth and the bodies from which all meteorites originate are made of similar materials. Earth's core consists of iron-nickel alloy, but its mantle is made mostly of magnesium silicates. Plenty of meteorite specimens made up of the same minerals as Earth's core have been recovered, but few meteorites from an asteroid's mantle have ever been found.

GEM STANDARD

Fresh iron-bearing olivine crystals can turn yellow, gold, or brown from terrestrial weathering. The most pristine are green in color and are designated as the gem peridot when polished. In 1902, when the 99-lb (45-kg) Marjalahti meteorite crash-landed in Russia, its olivine crystals were determined to be of such high quality that they are still used today as the standard for peridot.

POCKETS OF PALLASITE

Significant pallasite meteorite finds have been recorded around the world. A site near Brenham, Kansas, has yielded more than 5,512 lbs (2,500 kg) of pallasite, including a 1,073-lb (487-kg) piece on view at the Field Museum in Chicago. This meteorite type is named for Peter Simon Pallas, who studied the 1,543-lb (700-kg) mass found in 1749 near Krasnoyarsk, Russia.

Sparkling Space Rock

The Arthur Ross Hall of Meteorites displays many fascinating specimens, but two slices, cut from the same single 3,307-lb (1,500-kg) found by a farmer in 1951 in Esquel, Argentina, stand out: their shimmering silvery iron-nickel surfaces are embedded with glittering yellow, orange, and green olivine crystals that glow when backlit.

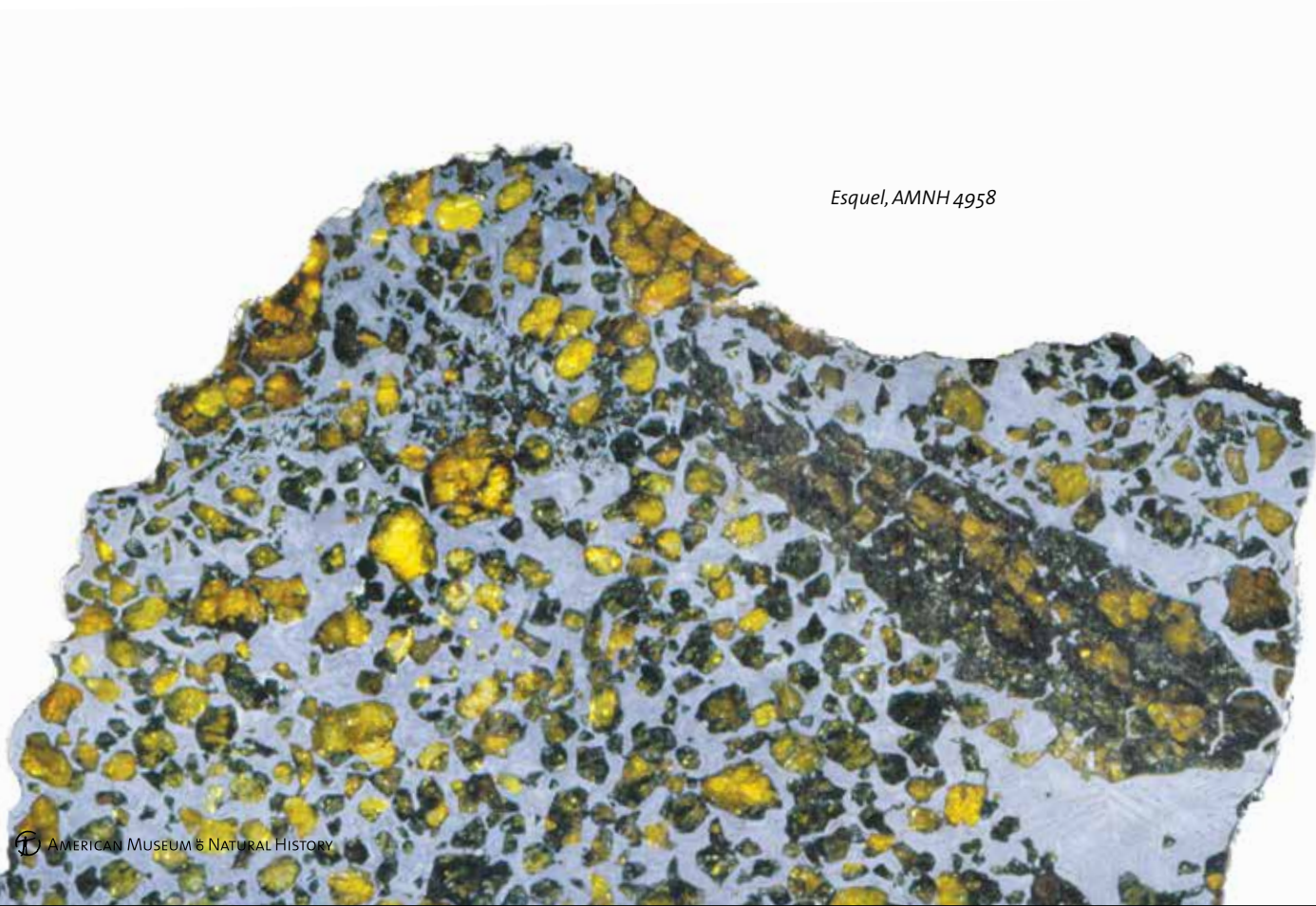
Olivine, which is commonly found in meteorites, is perhaps most strikingly evident in rare stony-iron meteorites like Esquel, a type of meteorite known as pallasite that makes up less than 1 percent of all known meteorites. But this rock-forming mineral is also found closer to home—in Earth's igneous rocks like basalt, gabbro, and peridotite, and on islands like Hawai'i and Iceland, where it shoots to the surface in the magma produced by volcanic activity.

Through this shared mineral inheritance, rare meteorites can offer clues about how planets like Earth formed billions of years ago. Look closely at the larger of the two Esquel meteorite slices in the hall, and you'll notice a dark streak in the nickel-alloy peppered with emerging clusters of orange olivine. These are traces of the dynamic processes of planetary formation in progress: liquid iron-nickel alloy separating from a cluster of silicate olivine crystals will eventually become a planet's core and mantle, respectively.

"Meteorites like Esquel offer a snapshot of the processes occurring between the cores and mantles of bodies in our solar system," says Denton Ebel, curator of meteorites in the Department of Earth and Planetary Sciences, who oversaw the hall's recent revitalization.

Visit the Arthur Ross Hall of Meteorites to see stunning examples of Esquel and other meteorites.

Esquel, AMNH 4958



J. Beckett / © AMNH



Ruby-throated Hummingbird

Ruby Flyer

Could there be a bird sighting more magical than that of a hummingbird? These fascinating tiny birds appear to hang stationary in mid-air, flapping their wings furiously, in some cases more than 50 times in a single second. They hover as they flit from flower to flower, eating about half their weight in nectar and insects each day.

The Ruby-throated Hummingbird (*Archilochus colubris*), pictured here, is the only hummingbird species in the U.S. east of the Mississippi River. This pretty pollinator enjoys a wide range of summer habitats, including open woodlands, forest edges, meadows, orchards, stream borders, backyards, and city parks. One was even spotted on a nest in New York's Central Park in 2014.

"While hummingbirds are seen in numbers every year in Central Park and throughout New York City in spring and fall, the nesting in Central Park was a very rare occurrence," says Paul Sweet, collection manager in the Department of Ornithology, who leads the Museum's bird walks.

A few words about coloration—we know most plants, as well as photosynthetic algae and microorganisms, are green because they contain chlorophyll, a chemical that converts sunlight into energy for growing through a process called photosynthesis. But why would a bird, like the male Ruby-throated Hummingbird, be mostly green? Blending in with foliage helps them escape the attention of winged predators above. Its brilliant red throat is a prime example of how bright hues are used throughout the natural world, on the other hand, a "come-hither" signal to potential mates.

Registration for Spring Bird Walks in Central Park, an exclusive benefit for Members, opens in February. For more information, see p. 16. You can also spot a Ruby-throated Hummingbird in *The Nature of Color*, opening March 6.

Michael McCarthy/Flickr

STUNT FLYERS

Like dragonflies, hummingbirds can fly in all directions: forward, backward, and upside down. The male Ruby-throated Hummingbird is an especially impressive aerialist during courtship, executing an elaborate series of dives, loops, and swoops, spreading its tail, and flashing its vivid red throat to the female.

FULL NEST

Immediately after mating, the male Ruby-throated Hummingbird leaves to seek out another female, while his mate proceeds to build a tiny cup-shaped nest. She lays two eggs, incubates them for about two weeks, and feeds the hatchlings for another three weeks. With two, or sometimes three broods per season, a female might start building another nest before her initial young fledge.

ON THE MOVE

For the winter, Ruby-throated Hummingbirds traditionally head south to Central America and Mexico—flying non-stop for 20 hours across the Gulf of Mexico. But as climate has warmed in recent years, some hummingbirds can be found overwintering in the Gulf Coast and southern Atlantic Coast states.

BIRDS OF ANOTHER FEATHER

Many species of hummingbird are brilliantly colored. Anna's Hummingbird males sport an iridescent magenta head. The Black-chinned Hummingbird's name is a misnomer because some males actually have a bright purple band instead. And the rare South American species Marvelous Spatuletail has a striking purple, green, and blue body, and two long tail feathers with purplish-blue racquet shapes on the ends.

THE

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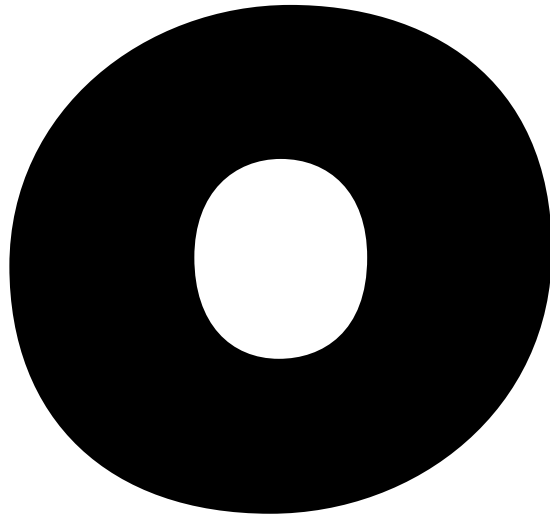


TOXIC

Earth and Venus are made of the same stuff. Why is one uninhabitable?



TWIN



Our planet Earth has a twin: Venus. The second planet from the Sun and our immediate neighbor has astoundingly similar qualities to our own world. It's close in size and mass, with an internal iron core and silicate mantle and crust. Its dense atmosphere has active weather-like phenomena.

This world also once had conditions that were very similar to those of early Earth. For 2 to 3 billion years, an active volcanic surface carved out vast plains and a mountainous landscape. Average temperatures ranged between 68 and 122 degrees Fahrenheit, and there may have even been shallow seas filled with liquid water.

But around 700 million years ago, when multicellular life was flourishing on Earth, large amounts of carbon dioxide filled Venus' atmosphere. Today, its punishing conditions are in stark contrast with those of our own blue-and-green Earth, with its perfect setting for hosting life. Why did these two worlds diverge?

EYES ON THE SURFACE

More than 40 spacecraft have visited Venus through the years, starting with the U.S. Mariner 2 in 1962. Currently, the Japanese mission Akatsuki is in orbit around Venus, studying atmospheric weather patterns such as the presence of lightning and looking for active signs of volcanism on the surface. But it was NASA's Magellan mission, from 1989 to 1994, that marked a turning point in our understanding of what was then a still-"elusive" planet.

When scientists received the first high-resolution images of the Venusian surface captured using Magellan's Synthetic Aperture Radar "they whooped with delight at the astonishing detail captured by the spacecraft's radar eyes," according to *The Washington Post*.

Magellan showed that Venus' mysterious surface is complex and unique. It features thousands of volcanoes, a uniform distribution of craters formed through violent impacts of meteorites, and deep channels and wide valleys formed by ancient lava flows.

But it's now been 25 years since we last took a close look at Venus' surface. "To understand why Venus is so different from Earth, we'll need to return to Venus with the right instruments, measure the composition of the surface, and look at how recent the last volcanic activity was," says Denton Ebel, curator in the Museum's Department of Earth and Planetary Sciences, who is curating the new Hayden Planetarium Space Show *Worlds Beyond Earth*.

GREENHOUSE PLANET

When we do return, we'll need to send robots in our stead. While Venus has a gravity similar to Earth's, the conditions on the ground would be deadly for human explorers. Its atmosphere is almost entirely made up of carbon dioxide, so thick that the pressure on the human body would feel like swimming 3,000 feet below the oceans' surface. Venus, which is closer to the Sun than Earth by 26 million miles, also receives about twice as much sunlight per day.

Our ability to render planets like Venus is nothing short of astonishing, thanks to past and current space missions and the data they provide.

CARTER EMMART
Director of Astrovisualization

There's another invisible but vital difference between Venus and Earth—a magnetic field.

On Earth, the magnetic field created by our planet's churning liquid iron core acts like a shield, deflecting solar wind particles. Venus, by comparison, rotates at an extremely slow rate, which is likely why it never formed a magnetic field. Without this powerful barrier against solar winds, its shallow seas dried up. With its water finally stripped away, the buildup of carbon dioxide in Venus' atmosphere reached a point of no return, trapping solar energy as scorching heat. Temperatures soared to nearly 900 degrees Fahrenheit—hot enough to melt lead—and created thick, toxic clouds of sulfuric acid that move so furiously they circle the planet every five days.

Visualizing these harsh conditions for *Worlds Beyond Earth* was no easy feat. But *Worlds Beyond Earth* takes viewers in for a close look. "Our ability to render planets like Venus is nothing short of astonishing, thanks to past and current space missions and the data they provide," says Carter Emmart, the Museum's director of astrovisualization. "We're not exaggerating the color, contrast, or the height of anything. In the Space Show, when we approach Venus, it's cloud enshrouded. But the reveal of the surface, imaged by radar, will be exciting."

Was Venus ever habitable? We don't yet know. Determining whether Venus ever hosted life may help us better understand the ingredients required for an Earth-like world.

"Venus and Earth are almost identical in terms of composition, but their atmospheres have evolved differently," says Ebel. "In addition to a magnetic field, Earth has microbial life which caused its atmosphere to become oxygenated over billions of years. Earth's atmosphere can be compared to the skin of an apple: it's very thin, but it's everything to us?"

Venus' carbon dioxide-choked atmosphere, on the other hand, offers a view of a greenhouse planet's lonely fate.

See *World Beyond Earth* before it opens to the public. Member Preview Days run from January 18 through January 20. See p. 14 for details.

Worlds Beyond Earth is dedicated to the memory of Charles Hayden in celebration of the 150th anniversary of his birth and made possible by the generous support of the Charles Hayden Foundation.

Previous page: Venus and Earth are neighbors in our solar system.

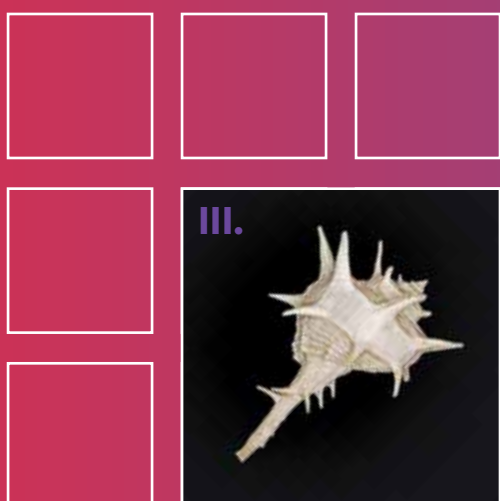
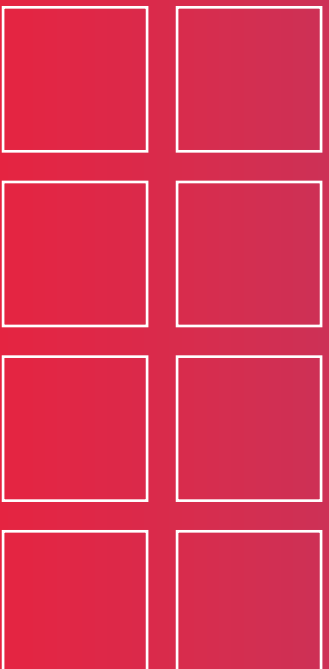
This page: The most detailed images we have of Venus were collected during NASA's Magellan mission, from 1989–1994. The elevation of the landscape in this NASA image is amplified by 22.5 times.

POWER COLORS

Precious Insects

In South America and Mexico, red dye was produced from the tiny cactus-eating insects *Dactylopius coccus* (I.) as early as the first millennium A.D. The Inca used red to signify nobility and power: the maskapaycha (II.), the royal crown traditionally worn by the Incan Emperor (Atahualpa, pictured, fought a civil war against his half brother to claim the title), was embellished with fringe and tassels made of red-dyed fine wool.

By the time Spanish conquistadors landed in South America, demand for red dye had been growing in Europe, where red was also associated with royalty and red dye was derived from *Kermes vermilio* insects. Europeans eagerly took up the new South American dye, called cochineal, which became Spain's third most valuable New World export after gold and silver.



HOW DOES A COLOR COME TO SIGNIFY POWER?

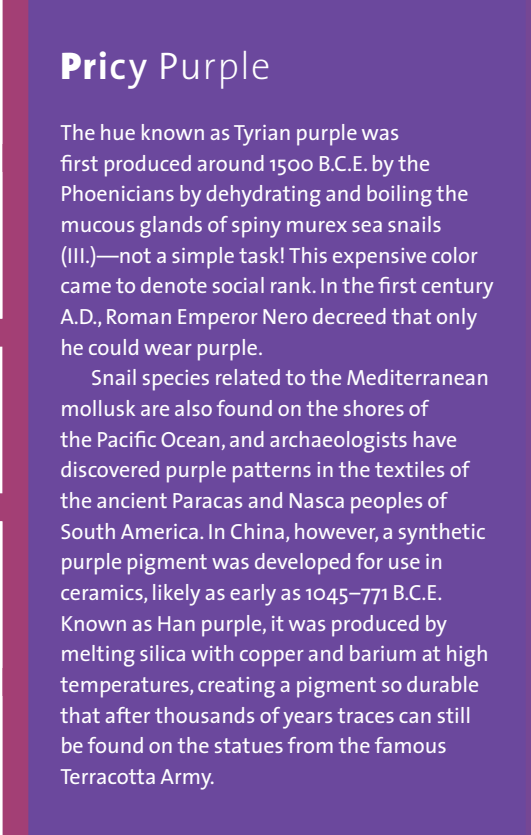
THROUGHOUT TIME, HUMANS HAVE GIVEN SPECIAL SIGNIFICANCE TO RARE FABRIC DYES—INCLUDING RED, PURPLE, AND BLUE.



Pricy Purple

The hue known as Tyrian purple was first produced around 1500 B.C.E. by the Phoenicians by dehydrating and boiling the mucous glands of spiny murex sea snails (III.)—not a simple task! This expensive color came to denote social rank. In the first century A.D., Roman Emperor Nero decreed that only he could wear purple.

Snail species related to the Mediterranean mollusk are also found on the shores of the Pacific Ocean, and archaeologists have discovered purple patterns in the textiles of the ancient Paracas and Nasca peoples of South America. In China, however, a synthetic purple pigment was developed for use in ceramics, likely as early as 1045–771 B.C.E. Known as Han purple, it was produced by melting silica with copper and barium at high temperatures, creating a pigment so durable that after thousands of years traces can still be found on the statues from the famous Terracotta Army.



MEMBER PREVIEWS

THE NATURE OF COLOR: MARCH 6–8

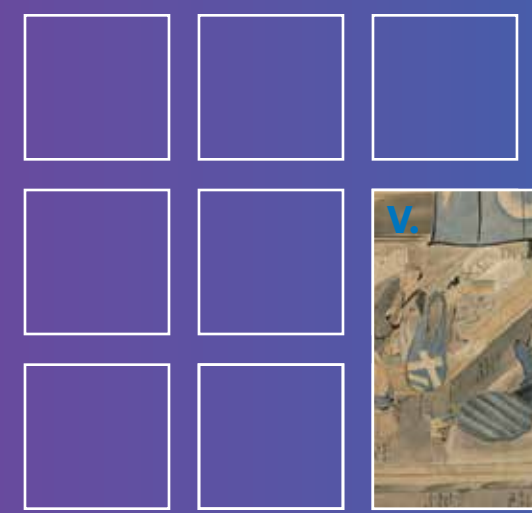
GET A FIRST LOOK AT THE NATURE OF COLOR BEFORE IT OPENS TO THE PUBLIC!

MEMBER PREVIEWS BEGIN MARCH 6–8
 Tickets are available starting Tuesday, February 25 by phone at 212-769-5200, Monday–Friday, 9 am–5 pm

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

Generous support for The Nature of Color has been provided by the Eileen P. Bernard Exhibition Fund.

The Nature of Color is generously supported by Chase Private Client.



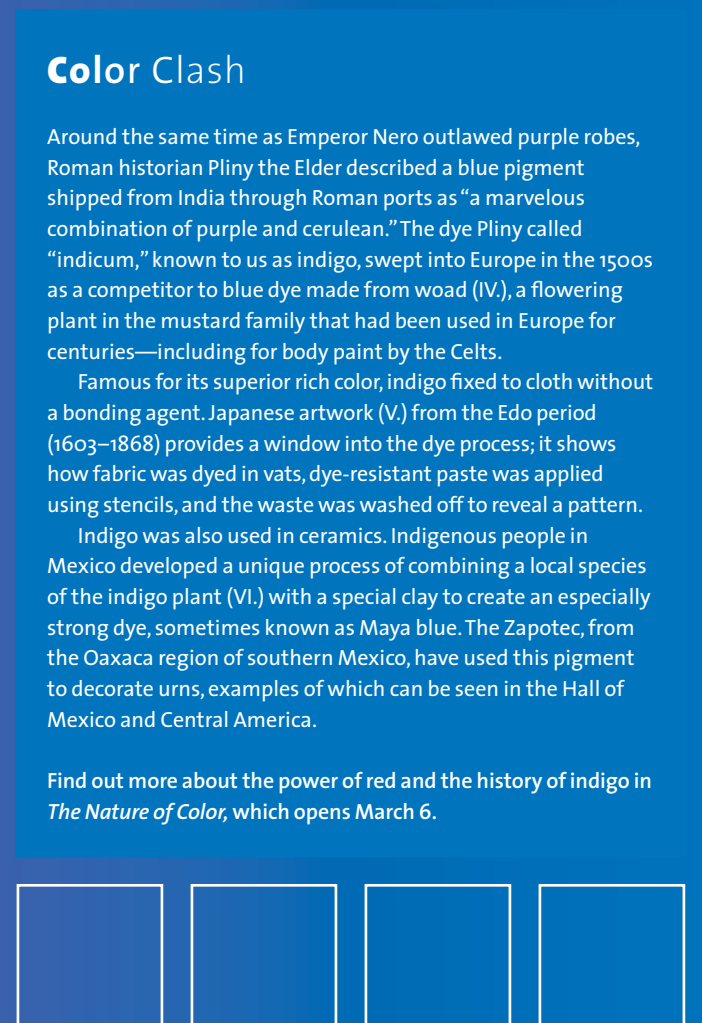
Color Clash

Around the same time as Emperor Nero outlawed purple robes, Roman historian Pliny the Elder described a blue pigment shipped from India through Roman ports as “a marvelous combination of purple and cerulean.” The dye Pliny called “indicum,” known to us as indigo, swept into Europe in the 1500s as a competitor to blue dye made from woad (IV.), a flowering plant in the mustard family that had been used in Europe for centuries—including for body paint by the Celts.

Famous for its superior rich color, indigo fixed to cloth without a bonding agent. Japanese artwork (V.) from the Edo period (1603–1868) provides a window into the dye process; it shows how fabric was dyed in vats, dye-resistant paste was applied using stencils, and the waste was washed off to reveal a pattern.

Indigo was also used in ceramics. Indigenous people in Mexico developed a unique process of combining a local species of the indigo plant (VI.) with a special clay to create an especially strong dye, sometimes known as Maya blue. The Zapotec, from the Oaxaca region of southern Mexico, have used this pigment to decorate urns, examples of which can be seen in the Hall of Mexico and Central America.

Find out more about the power of red and the history of indigo in *The Nature of Color*, which opens March 6.



THE PLANETARIUM'S PATRON

HOW NEW YORK CITY GOT ITS STARS.



In 2020, the Museum is celebrating the legacy of Charles Hayden, whose vision made the Hayden Planetarium possible and brought the universe to New York City.

AMNH Library/Image no. 316044
AMNH Library/Image no. 287187

CHARLES HAYDEN WAS BORN IN 1870, the same year a total solar eclipse brought a team of scientists together to observe the totality over Sicily with the relatively new technology of spectroscopy, which split light into wavelengths that could be analyzed for various properties. The expedition was a milestone in the nascent field of “physical astronomy”—or astrophysics, as we know it today. And the next few decades were an exciting age of discovery.

Researchers uncovered unknown aspects of the universe: the chemical makeup of stars, radio waves from space, that the Sun is mostly hydrogen, and that the Milky Way is just one of many galaxies. And Charles Hayden, whose life coincided with the opening of these new cosmic frontiers, would play a crucial role in bringing them to generations of New Yorkers and to visitors from around the world.

Although the Museum began planning “an astronomic section” in 1925, Chicago’s Adler Planetarium opened first, becoming the Western Hemisphere’s only planetarium in May 1930. Crowds flocked, and when Chicago opened the Century of Progress World’s Fair in 1933, attendance topped 1.2 million within a year. One of the starry-eyed planetarium visitors was Charles Hayden. The experience so thrilled him that, within just a few months and in the middle of the Great Depression, he pledged funds to help build a planetarium in New York City. “I believe the planetarium is not only an interesting and instructive thing but that it should give more lively and sincere appreciation of the magnitude of the universe,” Hayden told *The New York Times* and other newspapers. His gift went towards the creation of a Copernican exhibit on the first floor, which displayed the six planets nearest to the Sun revolving at their proper relative speeds, and a state-of-the-art Zeiss projector for the new building’s hemispherical dome. (For more about the Zeiss, see p. 22.) Hayden turned the first shovelful of earth at the groundbreaking for what would become his namesake planetarium in May 1934.

His hopes came true. When the planetarium opened to the public on October 3, 1935, lines stretched down the block. In its first year, the Hayden Planetarium drew more than half a million visitors, plus more than 150,000 New York City schoolchildren who were admitted without charge, to see the stars in the night sky or to listen to illustrated lectures. The 754-seat circular projection chamber featured a white dome of perforated stainless steel, which served as the screen on which images of the heavenly bodies were cast by the Zeiss projector, supplemented by lantern slides. Averaging nine shows a year, the Hayden Planetarium would cover such subjects as “4,000 Years of Astronomy,” “The Expanding Universe,” and the prescient “Rocket to the Moon.” In 1951, the Hayden Planetarium hosted the First Annual Symposium on Space Travel.

Although Charles Hayden died in 1937, his legacy of support for the educational mission of the Museum has continued through his foundation. Among other things, the Charles Hayden Foundation has contributed to periodic upgrades of the Zeiss projector, and, in 1999, provided a grant for the new Hayden Planetarium within the Rose Center for Earth and Space.

“Charles Hayden was deeply inspired by our universe and wanted to bring that sense of awe to others, especially to the next generation,” says Kenneth D. Merin, president and CEO of the Charles Hayden Foundation. “The Hayden Planetarium continues to be the ultimate place for visitors of all ages, and especially for New York City students, to be transported and to discover the vastness and beauty of the cosmos for themselves.”

When the Museum’s new Space Show, *Worlds Beyond Earth*, which was developed with the support of the Hayden Foundation, opens on January 21, it will kick off a year of Hayden Planetarium programs to celebrate the man behind New York’s beloved planetarium. It will be a fitting tribute to the person who was committed to sharing the magnitude of the universe with others, and a reminder of the mysteries, wonders, and discoveries that still await. 🌌

A year of Hayden Planetarium programming begins this month. See p. 14 for details.

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 December 6, 2019. Please check amnh.org/calendar for updates.

JANUARY

In 2020, the Museum is celebrating the legacy of Charles Hayden, whose vision made the Hayden Planetarium possible and brought the universe to New York City.

SciCafe: The Future of Personalized Medicine

Wednesday, January 8

Doors open at 6:30 pm

Program starts at 7 pm

Free with RSVP

Cash bar, for adults 21+

Imagine a world in which healthcare is tailored to your DNA. This is the promise of personalized medicine. Meet **Marianne Legato**, a pioneer in this field, whose work focuses on customizing medical treatments to the needs of different populations. Legato discusses balancing medical advancements with ethical challenges in the evolving healthcare landscape.

Night at the Museum Sleepover

Fridays,

January 10 and 17,

February 21 and 28, and

March 6 and 27

Saturdays,

January 25 and March 21

6 pm–9 am

\$140

Recommended for families with children 6–13 years old
Registration required; call 212-769-5200

Head out with flashlights in search of adventure. Meet your relatives in the Spitzer Hall of Human Origins. Climb the stairs and enter the age of dinosaurs, standing beneath a fearsome *T. rex*. Settle down beneath the 94-foot-long blue whale, next to African elephants, or at the base of a striking volcanic formation.



Member Preview Days:

Worlds Beyond Earth

Saturday–Sunday, January 18–19,

10:30 am–5 pm

Monday, January 20,

10:30 am–4 pm

Free

Tickets available starting

Monday, January 13

Call 212-769-5200

Discover the surprisingly dynamic nature of the worlds that share our solar system and the unique conditions that make life on Earth possible. Join us for a first look at a journey far beyond our own blue planet to marvel at the latest discoveries about our cosmic neighbors.

Scutes + Scales: An Evening Reptile Encounter and Reception

Friday, January 24

6:30–8 pm

\$35

21+

Meet Museum scientists from the Department of Herpetology for this exciting evening celebration of amphibians and reptiles. Meet live frogs, lizards, snakes, and tortoises from all over the world (and a few favorite specimens from the collection too). Then, with a cocktail in hand, raise a glass and toast these critters and the important research our scientists undertake.



Animal Encounters: Reptiles and Amphibians

Saturday, January 25

11 am, 1 pm, and 3 pm

\$15

Enjoy for an exclusive animal encounter with scientists from the Museum's Department of Herpetology. Get an up-close introduction to extraordinary and colorful snakes, tortoises, lizards, and frogs from all over the world! Discover fun facts about the morphology and ecology of these amazing critters (and a few favorite specimens from the Museum's collection) and learn about our own biologists' research.

Hall Tour: What's New in the Cosmos?

Sunday, January 26

10:30 am and 1:30 pm

Free

Science is moving fast. Powerful new telescopes and techniques allow astronomers to explore the universe like never before. In 1999, there were fewer than 30 exoplanets detected. Now we know of thousands. Join an experienced Museum tour guide as you explore the Rose Center for Earth and Space and hear about the latest discoveries from the cosmos.

Current Space Exploration Missions

Tuesday, January 28

7 pm

\$12

At this Astronomy Live program, explore the latest and greatest highlights of the ongoing space missions in our solar system and beyond. **Emily Rice** and **Brian Levine** take you on a trip to the Sun with the Parker Solar Probe, then travel to the far edges of space with New Horizons and Voyager 2 and check out different nations' plans for future missions to explore everything in between.

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–Thursday, 1:30–5:30 pm

Saturday, Sunday, and public

school holidays, 10:30 am–1:25 pm

and 2:15–5:10 pm

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

Gateway Storytime

Free

On Friday mornings during the school year, children ages 2–5 are invited to the Discovery Room for storytime. Space is limited and tickets are distributed on a first-come, first-served basis.

Volcanoes: The Fires of Creation

The story of volcanoes is the story of planet Earth's creation—and the story of us. Follow intrepid explorer **Carsten Peter** on an adrenaline-filled trip across the globe, from Hawai'i's recent Kilauea eruption to the archaeological ghost town of Pompeii, to discover how volcanoes have created extraordinary ecosystems and wildlife habitats.

Captioning devices are available.



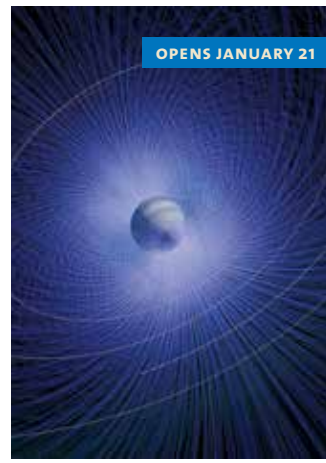
OPENS JANUARY 6

IN 2D AND 3D

Worlds Beyond Earth

How is the icy surface of Jupiter's moon Io volcanically active? What is the atmosphere like on Saturn's moon Titan? In stunningly detailed scenes drawn from real data—including visualizations of Mars and Saturn's rings—with narration by Academy Award winner **Lupita Nyong'o**, *Worlds Beyond Earth* takes viewers on a remarkable journey around our solar neighborhood.

Captioning devices are available.



OPENS JANUARY 21

The Nature of Color

Why do some colors make us happy and others make us, well, blue? Why did some animals evolve to stand out and others to blend in? Featuring intricate models, cultural objects, and interactive exhibits, this immersive exhibition lets visitors connect with color through experimentation and play.



OPENS MARCH 9

T. rex: The Ultimate Predator

Everyone knows *Tyrannosaurus rex*. But do 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 of hatchlings, juveniles, and a full-grown, towering *T. rex*, with engaging interactives that will reveal the amazing story of this iconic dinosaur.





Winter Lunchtime Bird Walks
Eight Tuesdays,
January 28–March 17
Noon–1:30pm
\$70
 Enrollment is limited. For more information, call the Bird Walk Hotline at 212-313-7579. Glimpse owls, hawks, and woodpeckers in the woods as ornithologist **Paul Sweet** guides you through three Central Park habitats. *Registration for Spring Bird Walks begin Tuesday, February 4.*

FEBRUARY

Meet the Scientist
Saturday, February 1
2:15 pm, 3 pm, and 3:45 pm
 Discovery Room
Free
 Children ages 7 and up are invited for talks with Museum scientists. Guest speakers will share their passion for science and bring along their latest findings. Free passes are distributed starting the morning of the program on a first-come, first-served basis.

SciCafe: How to Motivate Action on Climate Change

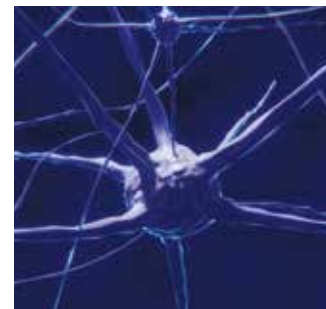
Wednesday, February 5
 Milstein Hall of Ocean Life
 Doors open at **6:30 pm**
 Program starts at **7 pm**
Free with RSVP
 Cash bar, for adults 21+
Shahzeen Attari explores how people think about energy use and climate change using methods from engineering, public policy, and psychology. Her research spans systems thinking and the factors that influence our perceptions of natural resources. Hear how stories can be harnessed to motivate action on climate change.

Hall Tour: Species and Ecosystem Survival

Saturday, February 8
10:30 am and 1:30 pm
Free
 With an experienced Museum guide, learn about the different organisms, known as keystone species, that other species within an ecosystem rely on for survival, from wolves in Yellowstone to small crustaceans in the oceans.

Exoplanets and NASA's TESS Mission

Monday, February 10
7 pm
\$12
 The Transiting Exoplanet Survey Satellite (TESS) launched on April 18, 2018, with a mission to search for new planets outside our solar system. Since these exoplanets typically orbit stars that are bright, scientists are also able to search for them using ground-based telescopes around the world. At this Frontiers Lecture, NASA scientist **Elisa Quintana** presents highlights from TESS's first year in space and discusses how a gold mine of data from the satellite will further our understanding of space.



New Science, New Solutions: Technology and the Brain

Tuesday, February 11
7 pm
\$12
 Can babies' exposure to digital technologies such as smartphones and touchpads affect the way their brains develop? How is technology shaping our cognitive abilities, attention span, and mental prowess? As "digital natives" enter the workforce, employers must find ways to balance the skills and capabilities of a new generation with the expertise and experience of those who are less digitally savvy. This panel discussion, led by neuroscientist **Adam Gazzaley**, explores some of the neurological advantages and challenges of living in a digitized world.

The Butterfly Conservatory

This popular live-animal exhibition features up to 500 free-flying tropical butterflies from the Americas, Africa, Asia, and Australia. Housed in a tropical vivarium with flowering plants, see iridescent blue morphos, striking scarlet swallowtails, and more.



Addressing the Statue

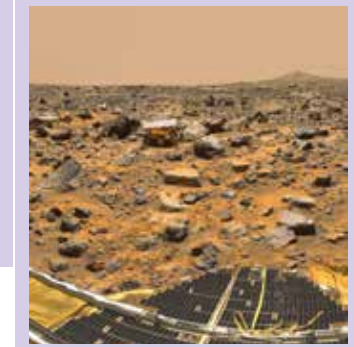
On view in the Akeley Gallery, this exhibition provides context about the historic equestrian Theodore Roosevelt statue on the Museum's front steps and how it is interpreted today.



MARCH

Mars Madness

Monday, March 2
7 pm
\$12
 NASA's Mars 2020 rover mission is set to launch in the summer of 2020. It will explore the planet's geology, test for signs of life, and analyze the potential habitability of Earth's neighboring world for humans, all while collecting samples to bring back home. Mission scientist and Brown University professor **Jack Mustard** at our March Frontiers Lecture explains how the landing site, Jezero crater, was determined, and how Mars 2020 is already setting the stage for future trips to the red planet.



SciCafe: Sea Turtles and Geomagnetic Navigation

Monday, March 4
Doors open at 6:30 pm
Program starts at 7 pm
Free with RSVP
 Cash bar, for adults 21+
 How do turtles find their way around the oceans? Biologist **Ken Lohmann** is studying how sea turtles use Earth's magnetic field to navigate long distances by following baby turtles with sensors. But human intervention and climate change are affecting turtles' navigation, complicating migration patterns and potentially jeopardizing their seasonal schedules, making tracking their movements all the more challenging.

Milstein Science Series: Polar Bears

Sunday, February 23
11 am–4 pm
Free
 On the eve of International Polar Bear Day, celebrate this phenomenal animal. Learn about its behavior, diet, and territory, and how climate change has made it a vulnerable species. This family-friendly festival dives into all things polar bear with activities, show-and-tell with Museum collections, and an interactive theater performance. Plus, scientists will be on hand to discuss conservation, polar bears' predatory nature, and how humans have interacted with these amazing mammals through history.



Our Cosmic Ballet

Tuesday, February 25
7 pm
\$12
 All objects in the universe are in constant motion. Throughout our 13-billion-year history, and looking forward into the not-so-distant future, stars zip by each other, space objects collide, and galaxies merge. At this February Astronomy Live program, astrophysicist **Jackie Faherty** uses the power of the Hayden Planetarium to show guests the cosmic ballet of stars and galaxies as they dance around each other through time.



Worlds Beyond Earth is dedicated to the memory of Charles Hayden in celebration of the 150th anniversary of his birth and made possible by the generous support of the Charles Hayden Foundation.

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

*Generous support for The Nature of Color has been provided by the **Eileen P. Bernard Exhibition Fund**.*

*The Nature of Color is generously supported by **Chase Private Client**.*

*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**.*

**Member Preview Days:
The Nature of Color**
Friday–Sunday,
March 6–8

10 am–5 pm
Free
Tickets are available starting Tuesday, February 25
Call 212-769-5200
Color is woven so tightly into our lives that we rarely stop to question what it is and how it works. The new exhibition *The Nature of Color* reveals how color carries information both in nature and across cultures. Discover how color is used in the natural world to help organisms survive and reproduce and how humans use it in various cultures to signal social status, group affiliation, and more. Dance with color shadows, mix and split different colors of light in a Color Lab, and even create collaborative artworks.

Hall Tour: Predator and Prey
Sunday, March 15
10:30 am and 1:30 pm
Free

Go on a tour with an experienced Museum guide of the Hall of North American Mammals and the Milstein Hall of Ocean Life, and learn about the complex relationship between predator and prey through these halls' terrestrial and aquatic habitat dioramas.

**Neuroscience Night:
Our Wonderful Brain**
Thursday, March 19
7 pm

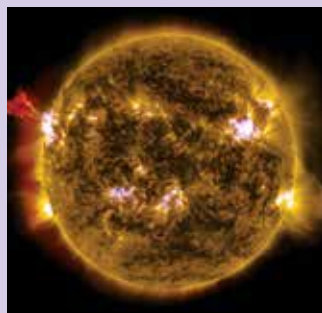
\$35 (includes 2 drinks)
For adults 21+, cash bar
With a glass of wine in hand, mix, mingle, and discover things you never knew about your own brain! Enjoy exclusive after-hours access to the Spitzer Hall of Human Origins, and participate in activities, challenges, and experiments led by neuroscience researchers and educators. Find out more about what makes the human brain unique in lightning talks by neuroscientist **Suzana Herculano-Houzel**.

**Brain Awareness
Weekend Drop-Ins**
Saturday, March 21–
Sunday, March 22
Noon–5 pm
Free

Visitors of all ages can drop into the Educational Lab in the Spitzer Hall of Human Origins to celebrate the wonders of the brain. Learn how this remarkable organ evolved in animals to make sense of surroundings and guide behaviors. Join neuroscientists leading informal discussions and activities with visitors, and discover the cells and systems responsible for memory, sensation, movement. Inspired by our new exhibition *The Nature of Color*, we will explore how our perception of color can change our minds and influence our actions.

Hit by the Sun
Tuesday, March 31
7 pm
\$12

Every day NASA monitors the activity of the Sun and forecasts space weather to avoid interference with thousands of satellites and spacecraft. Join Museum Director of Astrovisualization **Carter Emmart** at Astronomy Live to see what tools scientists use to predict solar weather so they can take proper precautions when launching new spacecraft—and astronauts—into space.



APRIL
Save the Date!
EarthFest
Saturday, April 18
Beginning at 7 am
Free

From early-morning yoga to special performances, visitors will be immersed in art, science, and culture at this festival honoring Earth Day. Participate in hands-on activities, see surprise guest stars on our main stage, and celebrate the beautiful planet we call home.



Program Credits:

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.

Additional support has been provided by the Ralph M. Cestone Foundation, the Louis and Virginia Clemente Foundation, the Ducommun and Gross Family Foundation, the Larkin Family, the V. and L. Marx Foundation, and the Jane and Frances Stein Foundation.

New Science, New Solutions: Technology and the Brain is generously supported by the Abel Shafer Public Program Fund, a fund created by the Arlene B. Coffey Trust to honor the memory of Abel Shafer.

Brain Awareness Weekend Drop-Ins and Neuroscience Night: Our Wonderful Brain are programs of the Sackler Brain Bench, part of the Sackler Educational Laboratory for Comparative Genomics and Human Origins.

Select Sackler Educational Labs are offered free of charge through the Con Edison STEM Days Out program.

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.

Select Hayden Planetarium Programs are sponsored by JetBlue.

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JANUARY

8
WEDNESDAY
SciCafe: The Future of Personalized Medicine
After-hours Program

10
FRIDAY
A Night at the Museum Sleepover

17
FRIDAY
A Night at the Museum Sleepover

18–20
SATURDAY–MONDAY
Member Preview Days:
Worlds Beyond Earth
Member Program

24
FRIDAY
Scutes + Scales: An Evening Reptile Encounter and Reception
Member Program

25
SATURDAY
A Night at the Museum Sleepover

Animal Encounters: Reptiles and Amphibians
Member Program

26
SUNDAY
Hall Tour: What's New in the Cosmos?
Member Program

28
TUESDAY
Current Space Exploration Missions
Hayden Planetarium Program

Winter Lunchtime Bird Walks begin
Member Program

FEBRUARY

1
SATURDAY
Meet the Scientist Family Program

5
WEDNESDAY
SciCafe: How to Motivate Action on Climate Change
After-hours Program

8
SATURDAY
Hall Tour: Species and Ecosystem Survival
Member Program

10
MONDAY
Exoplanets and NASA's TESS Mission
Hayden Planetarium Program

11
TUESDAY
New Science, New Solutions: Technology and the Brain
Special Event

21
FRIDAY
A Night at the Museum Sleepover

23
SUNDAY
Milstein Science Series: Polar Bears
Family Program

25
TUESDAY
Our Cosmic Ballet
Hayden Planetarium Program

28
FRIDAY
A Night at the Museum Sleepover

MARCH

2
MONDAY
Mars Madness
Hayden Planetarium Program

4
WEDNESDAY
SciCafe: Sea Turtles and Geomagnetic Navigation
After-hours Program

6
FRIDAY
A Night at the Museum Sleepover

6–8
FRIDAY–SUNDAY
Member Preview Days:
The Nature of Color
Member Program

15
SUNDAY
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Member Program

19
THURSDAY
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Special Event

21
SATURDAY
A Night at the Museum Sleepover

Brain Awareness Weekend Drop-Ins
Special Event

22
SUNDAY
Brain Awareness Weekend Drop-Ins
Family Program

27
FRIDAY
A Night at the Museum Sleepover

31
TUESDAY
Hit by the Sun
Hayden Planetarium Program

APRIL
18
SATURDAY
Save The Date! Earthfest
Special Event

Marine Life on the Mezzanine

New Discovery Room Display Sheds Light on Aquatic Ecosystems



Top: One of the new tanks is a mini habitat with animals from the East River.

Bottom: Visitors can observe a tropical coral reef up close.

Right: Erika Saur, who developed parts of the exhibit, visits in the Discovery Room.

The mezzanine level of the Museum's Discovery Room is a special spot—a place for children ages 8 and up to explore pond life through a microscope, track earthquakes in real time on a seismograph, use a spectrophotometer to identify gases, and more. Recently, it got a striking new addition designed by the Museum's Children and Family Learning team: a new marine life exhibit, anchored along the back wall.

Here, set within handsome wooden display cases, are two new fish tanks. One provides a peek inside a tropical coral reef, complete with miniature mangrove trees and mushroom corals, feather duster tube worms, and sea urchins, among a dozen or so species of plants and animals. The second tank contains sand shrimp, eastern mud snails, hermit crabs, larval horseshoe crabs, northern puffer fish, and schooling Atlantic silversides. All were seined in August from New York City's brackish East River by Museum staff in collaboration with the Brooklyn Bridge Park Environmental Education Center. As the fishes grow larger, they will be returned to their natural habitat, likely in spring and in summer, and replaced by others newly seined. Both tanks are intended to extend some of the themes about marine life and ecosystems most recently explored in the special exhibition *Unseen Oceans*, which closed in August.

The coral reef tank is dazzling in both color and content, but

is also a cautionary lesson. Warming seas, ocean acidification, and other environmental depletions are endangering coral reefs around the world. Recreating and maintaining this delicate saltwater ecosystem under the controlled conditions of a tank is a complicated undertaking. A visible sump tank maintains the water's optimal temperature, light, and oxygen levels. The sump tank also filters the water by straining out large particles, stirring proteins up into a column, and cultivating beneficial algae to remove waste that could poison the fish or cause potentially light- and life-choking unhealthy algae to take over the aquarium.

The exhibit is also a work in progress—by design. Suggestions from visitors are welcomed as the space evolves.

"A conversation with a visitor about how a certain fish looked like a unicorn helped us refine the language on the ID labels," says Daniel Zeiger, assistant director of Children and Family Learning. "Also, we didn't anticipate that so much of the water filtering equipment would be on display when first designing the exhibit. Visitors' questions led our intern to develop the guide." (See sidebar.) So, the next time you visit the Discovery Room, climb the steps to the mezzanine and ask to see the marine life display. Then, be sure to let the staff know what you think!

R. Mickens © AMNH

Rotunda / Winter 2020 / AMNH.org



Deep Dive for Interns

The Discovery Room isn't just a remarkable resource for children. It is also an invaluable training ground for Museum interns, two of whom contributed to this new marine life display.

Erika Saur, 16, pictured above, is a Museum intern-turned-volunteer who developed the exhibit's display screen about corals, which can be operated by visitors with a touchpad. It includes an interactive map of the world that locates various species of corals and sea anemones and relies on data from the Museum's dry coral collection. Saur also built in links to information about coral bleaching, conservation, videos, and more.

A second intern, Sylvia Niemann, 21, a senior at Binghamton University, researched and wrote a printed primer for the tropical coral reef tank's elaborate maintenance system. The six page hand-out offers visitors not only an explanation of the tank's machinery but also of the nitrogen cycle and the other processes at play in healthy ocean habitats. "Although a small tank like this lacks biodiversity and other attributes of the natural environment, my project opens up the conversation about the greater world that is the ocean," says Niemann, who plans to return to the Museum to work as a volunteer during school vacations.

Don't Miss the Discovery Room

In the Discovery Room, the lower level is for children ages 4–12 while the mezzanine level is dedicated to children 8 and older.

Passes for 40-minute-long sessions are free for Members and available on a first-come, first-served basis beginning at 1:30 pm on weekdays and 10:30 am on weekends or public school holidays.

Unseen Oceans and related programs were made possible by OceanX, an initiative of the Dalio Foundation, as part of its generous support of the special exhibition Unseen Oceans and its related educational activities and public programs.

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

Additional support has been provided by the Ralph M. Cestone Foundation, the Louis and Virginia Clemente Foundation, the Ducommun and Gross Family Foundation, the Larkin Family, the V. and L. Marx Foundation, and the Jane and Frances Stein Foundation.

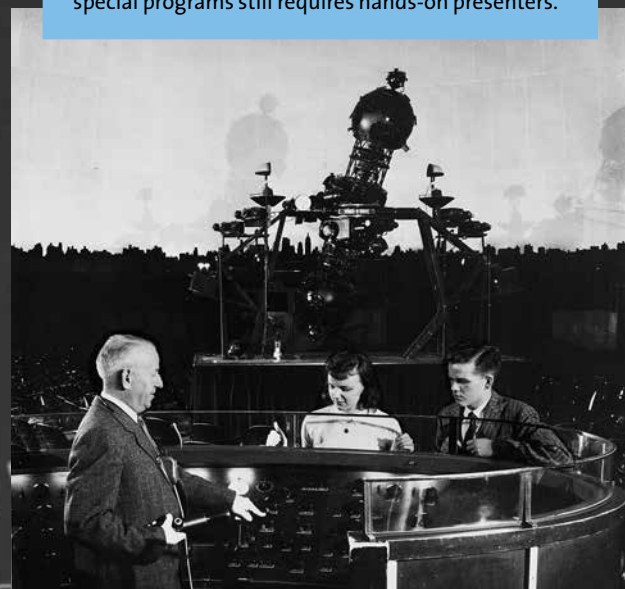
The Stars Above

As the Museum celebrates its 150th anniversary, each issue of *Rotunda* will bring you stories about iconic exhibits, spaces, and even instruments at the Museum.

Generations of New Yorkers have glimpsed the stars and planets in the Hayden Planetarium thanks to the Zeiss projector—four models of it, to be exact—beginning in 1935. Read on for milestones in the Zeiss projector's storied career at the Museum.

PLANETARIUM SHOWMEN

According to Thomas A. Lesser, a former Museum senior lecturer at the Hayden Planetarium, running the early Zeiss projectors required presenters—some of whom wore tuxedos for what was called the Sky Show—to operate the apparatus from behind a control console. Today, while the main Space Show is automated, use of the Zeiss for special programs still requires hands-on presenters.



PATH TO THE PLANETARIUM

In 1913, the founder and director of the Deutsches Museum in Munich turned to Carl Zeiss Optical Works to build a new planetarium that would show the movements of stars and planets. Following a pause during World War I, Zeiss' scientists and engineers spent five years developing a then-revolutionary moveable projector, which was finally unveiled to the public in 1925.

RECONNAISSANCE MISSION

After seeing the Zeiss in action shortly after the Munich planetarium opened, the Museum's then-Curator of Astronomy (and later director of the Hayden Planetarium) Clyde Fisher was determined that New York should have its own. "I believe it will attract more people to the Museum than anything we have ever had here," he remarked.

LENSES TO THE STARS

Early Zeiss models had two large projector-studded "star balls" at each end that tracked stars mechanically with a single motor and a gear system operated by technicians. Today's Mark IX is able to produce a 9,100-sun star field with high-intensity white light projected through 32 fiber-optic projectors. It has more than 30 motors controlled by 45 computers and a single "star ball" that uses built-in dimmers to make stars appear as if they're twinkling.

SPECIAL ORDER

The Mark IX includes several customizations for the Hayden Planetarium. Instead of the standard sky blue, the Museum's projector is painted black. Hayden planners also opted to forgo Zeiss' preferred interior paint color for the dome for a darker color officially named Planetarium Ultralight Gray. Engineers were pushed to improve projections of the Milky Way, and a local artist was recruited to replace drawings of the constellations.

FIRST IMPRESSIONS

The Zeiss projector was once an attraction in its own right. When the Mark IX was installed in 1999, City Council Member Stanley E. Michels of Manhattan told *The New York Times* about his memory of visiting the Hayden Planetarium at age 5: "I'll never forget the first time I saw the Zeiss. I thought it was a monster, a giant praying mantis. Forget about the stars in the dome—I could have looked forever at the projector."



© NASA



Earth and Venus are similar in composition. So why is Venus completely inhospitable? For more, see 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 on Central Park West (ground level via the driveway), the 81st 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, *The Nature of Color* 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.