

150 YEARS

AMERICAN MUSEUM OF NATURAL HISTORY

GENERAL OPERATIONS REPORT

FISCAL YEAR 2021

(JULY 1, 2020 TO JUNE 30, 2021)

INTRODUCTION

At the American Museum of Natural History, curiosity is sparked—and science is illuminated.

For more than 150 years, the Museum has energized generations of scientists, from renowned thinkers expanding the horizons of human knowledge to the youngest children intuitively discovering the fundamentals of scientific inquiry.

The current period, though marked by great challenge and uncertainty, has revealed the remarkable strength of this community of learners; affirmed the success of the Museum’s agility in work and delivery; and underscored the critical importance of the Museum’s enduring mission in science and education.



CONTENTS

RELIEF AND RECOVERY	2
SCIENCE	3
EDUCATION	5
EXHIBITIONS	7
CAPITAL PROJECTS	9
DIVERSITY, EQUITY, AND INCLUSION	11

RELIEF AND RECOVERY

The global COVID-19 pandemic ushered in a year unlike any other in the Museum's 150-year history—including its longest public closure, sweeping disruption of its normal operations, and unprecedented revenue losses.

In early Fiscal Year 2021, the Museum reopened to the public in a difficult and uncertain operating climate, with reduced capacity, shorter public operating hours, and without the initial use of key ticketed venues including the Hayden Planetarium and the LeFrak Theater.

After the Museum's opening in September 2020, the Hayden Planetarium and LeFrak Theater followed in March 2021, all with new operating procedures and health and safety measures. Organized camp group visits resumed in July 2021, a poignant and deeply hopeful moment in the Museum's—and New York City's—recovery.

Meanwhile, Museum scientists nimbly adjusted to the ongoing suspension of international fieldwork, continuing to publish, collaborate, mentor, and educate. Existing special exhibitions were extended to welcome as many visitors as possible, and were met with exceptionally high rates of visitation. Several education programs for the Museum's youngest learners returned onsite, while other programs for older children and youth that had transitioned online at the start of the pandemic continued virtually—an approach that has proven uniquely accessible. And several major capital projects, beacons of science and the future, progressed—including the heralded renovation and reopening of the Allison and Roberto Mignone Halls of Gems and Minerals, one of the Museum's most beloved permanent halls.



In April 2021, the Museum opened a COVID-19 vaccination site in partnership with the City of New York—under the iconic blue whale in the Milstein Hall of Ocean Life, now sporting a bandage on its fin.

SCIENCE

The Museum's scientific enterprise reveals new frontiers of human knowledge—knowledge that is deciphered and amplified for a worldwide community of learners across permanent halls, special exhibitions, and educational programming.

5 divisions	Collections of more than 34,000,000 specimens and artifacts	175 scientists	Richard Gilder Graduate School, conferring a Ph.D. in Comparative Biology and an M.A. in Teaching with a specialization in Earth Science
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With science underlying so many of today's most pressing concerns, the Museum plays an essential and leading role as a trusted, accessible source for scientific fact. During Fiscal Year 2021, Museum scientists advanced their critical mission-driven research despite the ongoing challenges of the pandemic, generating discoveries and accomplishments sampled in this section.

DIVISION OF ANTHROPOLOGY

AFFIRMING THE AGE OF AN EARLY HUMAN FOSSIL



Since its discovery in East Turkana, Kenya in 1974, scientists have debated the provenance of an important *Homo erectus* skull fragment. Widely believed to be the second-oldest *H. erectus* specimen ever found, some researchers argued that the fragment originated in a more recent fossil deposit before being shifted by wind or water. A study led by **Dr. Ashley Hammond** (Assistant Curator, Biological Anthropology) has resolved this debate, confirming that the specimen is 1.9 million years old. Using archival materials and geological surveys, the researchers pinpointed the specimen's locality, where they found no evidence of younger fossil material. Within 50 meters of the locality, they also found two new hominin specimens—a partial pelvis and a foot bone—that may be the oldest postcranial *H. erectus* specimens known to science.

DIVISION OF INVERTEBRATE ZOOLOGY

CHANGING OCEAN CONDITIONS DROVE CORAL EXTINCTION AND EVOLUTION



Coral reefs are scaffolded on skeletons of calcium carbonate, precipitated from the surrounding water. As the ocean warms and acidifies under global climate change, the calcification process is suppressed and existing calcified skeletons face dissolution. **Dr. Estefanía Rodríguez** (Curator, Cnidaria, Crustacea, and Other Invertebrate Phyla) delved into the evolutionary history of the class Anthozoa, comprised of corals and sea anemones, to outline how deep-time fluctuations in ocean geochemistry, sea surface temperature, and atmospheric CO₂ drove waves of extinction followed by diversification. With co-researchers including **Dr. Mercer Brugler** (Research Associate, Invertebrate Zoology), Dr. Rodríguez found that sea anemones and proteinaceous corals tend to diversify and expand following crises and extinctions of tropical reef builders, suggesting that a similar pattern may develop in today's oceans.

Researchers led by **Dr. Chase Nelson** (Visiting Scientist and former Gerstner Scholar in Bioinformatics and Computational Biology) have discovered a “hidden” gene in SARS-CoV-2, the virus that causes COVID-19. The gene, ORF3d, is an overlapping gene; these are abundant in viruses, but often overlooked. According to Dr. Nelson, “Overlapping genes may be one of an arsenal of ways in which coronaviruses have evolved to replicate efficiently, thwart host immunity, or get themselves transmitted.”

DIVISION OF PALEONTOLOGY

ANCIENT MAMMAL ANCESTORS INDEPENDENTLY EVOLVED “SCRATCH-DIGGING”

Dr. Jin Meng (Curator-in-Charge, Fossil Mammals; Acting Curator-in-Charge, Fossil Amphibians, Reptiles, and Birds) and his co-researchers have described two new species of mammaliamorphs, or mammal ancestors, that lived roughly 120 million years ago in northeastern China. The species are not closely related; one is a tritylodontid, a mammal-like reptile, while the other is a eutriconodontan, a cousin of modern marsupials and placental mammals. However, the fossils share the hallmark traits of “scratch-diggers,” including the short but powerful forelimbs and hands used for this burrowing behavior—indicating that these traits evolved separately in each animal.

DIVISION OF PHYSICAL SCIENCES

SPINNING STARS

Age is the most difficult stellar property to measure, but it is critical for studying the evolution of stars, planetary systems, and our own Milky Way Galaxy. **Dr. Ruth Angus** (jointly appointed as Assistant Curator, Astrophysics and Associate Research Scientist at the Simons Foundation’s Flatiron Institute Center for Computational Astrophysics) infers stars’ ages by measuring their rotation periods, or how fast they spin. As stars grow older, their rotations slow; but astronomers have recently discovered that the pace of this spin-down is not continuous. Using data from star clusters visible in the Sagittarius and Cygnus constellations, Dr. Angus and her co-researchers determined that the spin-down of low-mass stars stalls for at least 1.3 billion years—a period of consistency that is not yet incorporated into existing gyrochronology formulas, and that has important implications for accurately dating the coolest stars.



Dr. Cheryl Hayashi became the Museum’s new Senior Vice President and Provost of Science on July 1, 2021. As Provost, Dr. Hayashi will oversee the Museum’s five scientific research divisions, the Museum’s scientific collections, the Richard Gilder Graduate School, the Research Library, the Center for Biodiversity and Conservation, and more.

DIVISION OF VERTEBRATE ZOOLOGY

BIOFLUORESCENCE DISCOVERED IN ARCTIC FISH

Dr. John Sparks (Curator, Ichthyology) and **Dr. David Gruber** (Research Associate, Ichthyology) embarked on a Constantine S. Niarchos Expedition in 2019, diving beneath Greenland’s icebergs in search of glowing marine life. Dr. Sparks and Dr. Gruber initially reported widespread biofluorescence in fishes in 2014; although the trait is most common in tropical habitats, they hypothesized that biofluorescence might also be possible in the Arctic, fueled by a midnight Sun. After noting very little marine biofluorescence off Greenland’s eastern coast, they made a spectacular discovery: two variegated snailfish (*Liparis gibbus*) glowing both green and red. This finding, published in March 2021, represents the first time biofluorescence has been documented in an Arctic fish species.

In December 2020, the Museum was awarded a grant from the National Science Foundation (NSF) to establish a laboratory for the isolation of ancient DNA and the proteins preserved in biological tissues and environmental samples. The new laboratory, one of the few of its kind in the United States, will enable scientists within and beyond the Museum to unlock a trove of ancient biomolecular information.

EDUCATION

The Museum’s continuum of structured education programs reaches learners of all ages and levels of inquiry, from preschool to graduate school and beyond. During Fiscal Year 2021, the Museum offered its programs in virtual, onsite, and blended formats, reaching:

Students and teachers who viewed the Museum’s pilot Virtual Field Trips nearly 85,000 times	Families, students, and adults who viewed the Museum’s online programming more than 444,000 times	Nearly 900 pre-K-12 students in out-of-school-time programs	More than 4,500 educators through professional development opportunities
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During a year of continued challenge and uncertainty, the Museum’s educators continually innovated to maintain, strengthen, and inspire a local and global community of learners. The Museum built on the successes and lessons of its initial swift pivot to online delivery during the early months of the pandemic, providing its audiences with a variety of opportunities to learn safely while offering onsite, in-person access whenever possible—particularly important for the youngest students.

EARLY LEARNING

CHILDREN AND FAMILIES

With an emphasis on actively involving families in their children’s learning—a proven strategy for improving understanding—the Museum introduces young children to scientific inquiry and a wide variety of scientific disciplines by guiding them on explorations of the Museum’s renowned halls, special exhibitions, collections, and more. The Early Adventures Program for children ages two to six and The Science and Nature Program for children ages two to eleven returned onsite for in-person classes in Fall 2020, maintaining health and safety with lower class sizes, facial coverings, and social distancing. These two programs alone reached nearly 280 children and their families.

OLogy, the Museum’s award-winning science website for children, features engaging games, videos, and at-home activities that delve into a wide range of science topics, including marine biology, paleontology, and astronomy—allowing young learners to watch Museum scientists answer real questions from real kids. OLogy was visited 3.6 million times in Fiscal Year 2021, and its corresponding iPad app was downloaded over 53,000 times.

MIDDLE SCHOOL AND HIGH SCHOOL

The Museum’s middle and high school programs allow students to explore fields that are not always covered deeply in public schools, such as human evolution, archaeology, and astrophysics. In Fiscal Year 2021, the Science Research Mentoring Program (SRMP) for high school students, Science Alliance program for middle school students, and Lang Science Program for middle and high school students were offered remotely, and were among those that reached a total of over 330 science-interested students.



The Museum strives to document, communicate, and refine its educational programming through self-evaluation aligned with its commitment to access and equity. Through an NSF RAPID grant, the Museum studied 560 SRMP and partner program graduates—many from groups historically underrepresented in STEM—to better understand the pandemic’s impact on their academic trajectories. Preliminary findings revealed that nearly half of the students felt that their trajectory had been affected by the pandemic, and surfaced the supports that could help during the semesters ahead—like closer faculty guidance and peer mentorship. The Museum has made public these early findings, which have implications for the entire science education field.

URBAN ADVANTAGE

The Museum leads Urban Advantage, a partnership with seven other cultural institutions that is the largest formalized middle school science education program in the country—serving more than 46 percent of New York City’s public middle schools. Urban Advantage reached over 82,000 students and over 860 teachers remotely in Fiscal Year 2021, providing teacher professional development, parent outreach, classroom resources, and more. Urban Advantage Elementary, for grades 3-5, reached an additional 5,400 students.

EDUCATOR DEVELOPMENT

SUPPORTING NEW YORK’S SCIENCE TEACHERS

The Museum’s David S. and Ruth L. Gottesman Center for Science Teaching and Learning innovated in its offerings to provide educators with the unique support, mentorship, and resources they needed most during a year of continued challenge and uncertainty. The Gottesman Center reached over 3,000 educators and education professionals through a robust suite of online learning opportunities that focused on supporting newly remote and blended teaching and addressing the novel and often complex challenges facing teachers during the pandemic. New online sessions covered a range of topics including “Teaching Science Remotely Using Museum Resources,” “Nature Journaling for Culturally Expansive Teaching,” and “Genetics and Human Variation: Resources for the Virtual Classroom.”

THE NEXT GENERATION OF SCIENCE TEACHERS

The Richard Gilder Graduate School’s Master of Arts in Teaching (MAT) program shifted to blended program delivery for its candidates in Fiscal Year 2021. The MAT program is the only museum-based master’s program leading to teaching certification in the United States, and it leverages the Museum’s robust scientific resources, preeminent scientists and educators, and unique expertise in science education. By the close of Fiscal Year 2021 in June 2021, 105 MAT graduates were teaching more than 12,600 students, primarily in New York State.

The Museum was awarded a three-year NSF ITEST grant to create new opportunities for its SRMP students to learn and apply machine learning to scientific problems in the natural sciences. This effort will help address the lack of diversity in the field of artificial intelligence, which has resulted in the creation of biased algorithms, biased data sets, and an increased likelihood of automated discriminatory practices.

CELEBRATING SCIENCE WITH PUBLIC PROGRAMS

The Museum’s monumental shift to offering all of its public programs online in the latter half of Fiscal Year 2020 was greeted with such positivity and enthusiasm that it maintained this shift throughout Fiscal Year 2021, taking advantage of the unique accessibility and reach of platforms like YouTube and Facebook. Regular live programming including Astronomy Online (pictured at right), The Scientist is In, and the SciCafe series on Zoom drew children, families, and adults alike; the Museum also produced a virtual EarthFest event for Earth Day, the annual and highly anticipated Isaac Asimov Memorial Debate, programs for Climate Week NYC, and more. Through the end of Fiscal Year 2021, the Museum’s online programs were viewed over 444,000 times—including by many public school classes.



The Museum continued to offer programming centered on cultivating a science-based public understanding of the pandemic. On March 3, 2021, the SciCafe event “COVID-19 Pandemic Today” welcomed more than 400 attendees over Zoom. The event was hosted by Dr. Rob DeSalle (Curator, Molecular Systematics) and featured Dr. Jay Varma (Senior Advisor for Public Health, Office of the Mayor of New York City), who explained the state of the COVID-19 pandemic with a focus on New York City. Attendees also had the opportunity to participate in a Q&A with Dr. Varma.

EXHIBITIONS

Each year, the Museum’s scientists and in-house exhibition designers collaborate to transform complex, cutting-edge research into compelling and immersive learning experiences. Following the Museum’s reopening, and despite new capacity limits, these offerings were exceptionally popular—underscoring the engaging nature of the content and visitors’ eagerness to return.

SPECIAL EXHIBITIONS

[T. REX: THE ULTIMATE PREDATOR \(MARCH 8, 2019–MARCH 14, 2021, EXTENDED\)](#)

T. rex: The Ultimate Predator, curated by **Dr. Mark Norell** (Macaulay Curator and Curator-in-Charge, Division of Paleontology), introduced visitors of all ages to the famed *Tyrannosaurus rex* and entire tyrannosaur superfamily. The special exhibition’s features—including life-size models, interactive explorations of authentic data from fossils, CT scans, and microscope images, and a motion-activated, large-scale video projection of an animated *T. rex* in its natural habitat—told the story of *T. rex* from its initial discovery nearly one hundred years ago to its most recently unearthed relatives. During its entire run at the Museum, more than 745,000 visitors explored *T. rex: The Ultimate Predator*; remarkably, between its reopening in September 2020 and its final close in March 2021, it was visited by nearly one-third of all Museum ticketholders.



[THE NATURE OF COLOR \(MARCH 9, 2020–DECEMBER 5, 2021, EXTENDED\)](#)

Visitors continued to explore the ways color conveys information in nature and across cultures through stunning displays and thought-provoking interactive experiences in *The Nature of Color*. Curated by **Dr. Rob DeSalle** (Curator, Molecular Systematics), this special exhibition explains and demonstrates the meaningful roles played by color through innovative and exploratory activities grounded in Museum science and the latest discoveries. Between its initial opening just before the Museum’s temporary closure through the end of Fiscal Year 2021, *The Nature of Color* was visited by more than 164,000 learners—drawing nearly one-quarter of ticketed Museum visitors following the Museum’s reopening.





VOLCANOES: THE FIRES OF CREATION

On March 10, 2021, as New York City reopened movie theaters, the Museum’s historic Samuel J. and Ethel LeFrak Theater likewise reopened with the giant-screen film *Volcanoes: The Fires of Creation*. Adventurer and photographer Carsten Peter unearthed the exciting science of volcanism and showed audiences how volcanoes help shape extraordinary ecosystems and wildlife habitats.

CREATURES OF LIGHT (JUNE 2, 2021–SEPTEMBER 5, 2021)

Building on a successful initial run from 2012 to 2013, *Creatures of Light: Nature’s Bioluminescence* returned to the Museum—showcasing the extraordinary diversity of organisms that generate light and exploring the reasons why. The Museum’s exhibition team and **Dr. John Sparks** (Curator, Ichthyology) re-created a range of darkened environments for visitors to move through, fostering a deeper understanding of bioluminescent creatures ranging from familiar fireflies to the deep-sea anglerfish. Through the close of Fiscal Year 2021, more than 37,000 visitors met with the diversity of lifeforms that glow, blink, flash, and glitter.



WORLDS BEYOND EARTH

Worlds Beyond Earth, the newest Space Show produced by the Museum, resumed screening at the Hayden Planetarium Space Theater on March 24, 2021 with limited capacity. With engaging narration by Academy Award-winner Lupita Nyong’o, and breathtaking science visualizations, *Worlds Beyond Earth* guides audiences through the evolution of our solar system—and the singular refuge provided by our planet. *Worlds Beyond Earth* has been viewed by more than 148,000 visitors since opening in January 2020.



CAPITAL PROJECTS

ALLISON AND ROBERTO MIGNONE HALLS OF GEMS AND MINERALS

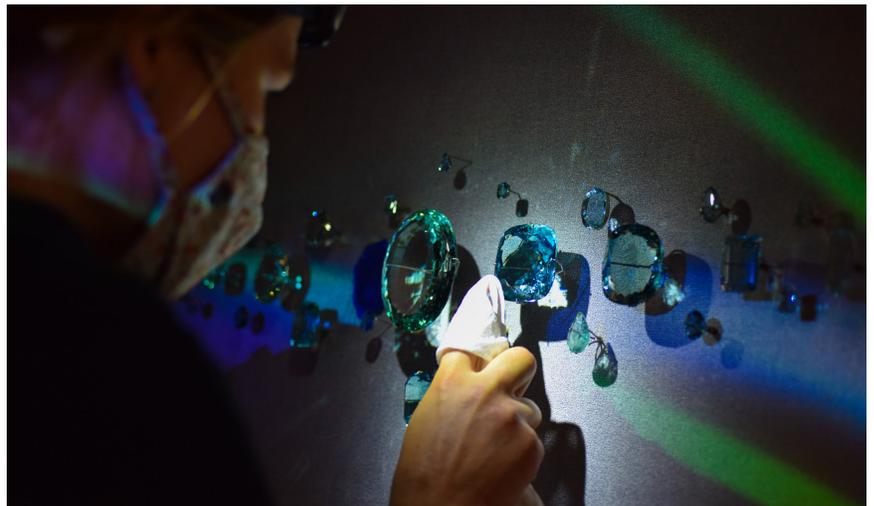
On June 12, 2021, the Allison and Roberto Mignone Halls of Gems and Minerals opened to the public following a multiyear renovation curated by Dr. George Harlow (Curator Emeritus, Earth and Planetary Sciences) and designed by Ralph Appelbaum Associates. A novel virtual queuing system enabled the Halls' first eager visitors—more than 37,000 through June 30 alone—to line up via their mobile devices while fostering social distancing.

The revitalized Mignone Halls, displaying some 5,000 specimens, reinterpret one of the world's greatest collections of minerals and gems. Longstanding favorites join previously little-seen treasures of the collection and spectacular new acquisitions to draw visitors into the fascinating science of mineral diversity, evolution, and classification—and the story of how minerals have been used and treasured across human history.

Within the Mignone Halls, the new Melissa and Keith Meister Gallery—the first temporary gallery within a permanent hall—opened with the inaugural show *Beautiful Creatures*. This breathtaking exhibition explored the unmatched allure of the natural world as an inspiration for jewelry design, showcasing animal-inspired pieces crafted over the past 150 years in a salute to the Museum's founding.



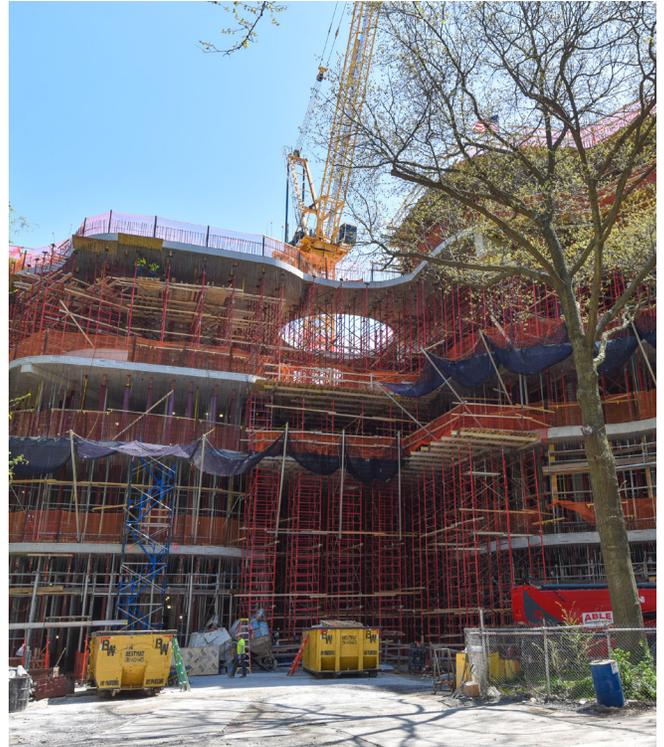
Moving the Mignone Halls' largest mineral specimens into place proved to be a complex challenge. Certain pieces are so massive that they could not fit through existing Museum entrances; a freestanding one-ton slab of orbicular granite, for example, was delivered through the as-yet unfinished entrance from the new Richard Gilder Center for Science, Education, and Innovation. The smallest minerals and gems, too, required meticulous care; specimens were gently cleaned with toothbrushes or ultrasonic baths before being arranged in bespoke display mounts.



RICHARD GILDER CENTER FOR SCIENCE, EDUCATION, AND INNOVATION

Designed by architect and MacArthur Fellow Jeanne Gang of Studio Gang and exhibition designer Ralph Appelbaum of Ralph Appelbaum Associates, the Richard Gilder Center for Science, Education, and Innovation will catalyze unprecedented opportunities to strengthen and advance the Museum’s mission in science and education.

Within the Gilder Center, the Susan and Peter J. Solomon Family Insectarium and year-round Butterfly Vivarium will immerse visitors in the world of insects, while the Invisible Worlds Theater will immerse audiences in science visualizations that transcend unaided human perception. The Museum’s Research Library will be reestablished in an expanded and enhanced space that is more visible and accessible to visitors. New classrooms arranged in age-defined learning zones will provide much-needed space for existing Museum education programs while generating the flexibility to respond to shifts in students’ needs over time. And for the first time, visitors will gain a glimpse into working collections areas through the soaring Collections Core, storing ten percent of the Museum’s total collections and showcasing their breadth and depth.



Soon after construction resumed at the Gilder Center site in June 2020, the project marked a significant milestone: work on the superstructure, the portion of the building that rises above its foundation, commenced in November 2020. The Gilder Center “topped out” at roughly 105 feet high on June 22, 2021.

NORTHWEST COAST HALL

During Fiscal Year 2021, the Museum’s project to restore, renovate, and reinterpret its historic Northwest Coast Hall achieved two important milestones in quick succession: construction within the Hall was completed in mid-September 2020, and case installation was completed in early October 2020. By the close of Fiscal Year 2021, the process of installing artifacts and finalizing text and graphics was more than half complete, and two of the Hall’s eight cultural alcoves—the Tlingit alcove and the Nuu-chah-nulth alcove—had been completed.

Upon the Northwest Coast Hall’s reopening, anticipated in Spring 2022, visitors will gain a contemporary view of the First Nations of the Pacific Northwest—as well as unparalleled exposure to one of the world’s most important collections of 19th and early 20th century Northwest Coast art and material culture, beautifully restored, conserved, and recontextualized. The project, co-curated by Nuu-chah-nulth artist and cultural historian Haa’yuups (Ron Hamilton) and Dr. Peter Whiteley (Curator, North American Ethnology), is deeply informed by collaboration with nine Consulting Curators and the communities represented in the Hall.



DIVERSITY, EQUITY, AND INCLUSION AT THE MUSEUM

The American Museum of Natural History is a global institution in one of the most diverse cities in the world. We are committed to building and sustaining a diverse and inclusive community, including addressing barriers to full inclusion of historically underrepresented groups. Recognizing that multiple voices and perspectives enrich our work, we embrace a broad definition of diversity and are dedicated to ensuring an environment where differences are valued and respected and where all members of our community are full and engaged participants in our mission.

The Museum’s Diversity, Equity, and Inclusion (DEI) Workplan, effective July 1, 2019, articulates actionable strategies and goals aligned with its Diversity and Inclusion Statement, above. The Workplan focuses on fostering and supporting diversity and representation both within the institution and across its scientific and student communities; envisions cultural programs and exhibitions that increasingly reflect the perspectives, contributions, and attendance of New York’s many cultural communities as well as those communities whose cultural material is in the Museum’s collections and on display; and aspires for the Museum to be experienced as a welcoming and accessible environment for visitors of all abilities and needs. Select efforts to support these goals during Fiscal Year 2021 follow.

IN THE CLASSROOM

The Museum introduced several new teacher professional development offerings centered on cultural representation and reflection. For teachers of kindergarten through high school, “Perspective Taking: Museum Dioramas” modeled ways to engage students in bringing their own experiences, cultural backgrounds, and perspectives to observing the Museum’s dioramas. The Museum also offered two workshops that highlighted strategies and resources for teaching about Haudenosaunee culture, native to North America’s Eastern Woodlands, in a remote setting. Seneca artist Marissa Manitowabi (Consultant; Former Curator, Seneca-Iroquois National Museum) hosted “Teaching about Haudenosaunee Culture in Your Virtual Classroom” for teachers of Grades 3-6, and “Bringing the Thanksgiving Address and Haudenosaunee Food Traditions into Your Virtual or Blended Classroom” for teachers of Grades 3-8.



From Onëögë:n to Gá:hgok
Steps for Making Boiled Cornbread

STEP 10

Spreading Lyed Corn

The next step is to spread out the lyed corn someplace where it can dry out well. To dry the corn, Marissa is spreading it on a window screen and running a fan nearby. In the summer, some people will put it out under the sun. Others use dehydrators to speed the process along.

The teacher professional development workshops “Teaching about Haudenosaunee Culture in Your Virtual Classroom” and “Bringing the Thanksgiving Address and Haudenosaunee Food Traditions into Your Virtual or Blended Classroom” informed the development of “From Onëögë:n to Gá:hgok—Steps for Making Boiled Cornbread,” a post-visit educator resource for the Hall of Eastern Woodlands Indians now available for free download from the Museum’s website (sampled above).

American Museum of Natural History
200 Central Park West
New York, NY 10024-5192
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