THE UNIVERSITY OF NEW MEXICO

2020 IMPACT REPORT

INTERDISCIPLINARY SCIENCE CO-OP

INTERDISCIPLINARY
SCIENCE CO-OP

2020 IMPACT REPORT

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DEAN'S MESSAGE

by Mark Peceny, PhD
Dean
College of Arts & Sciences

Five years ago, as UNM was designing a new facility for the Department of Physics & Astronomy, the inaugural Data-to-Knowledge Symposium sparked an idea to better support the efforts of our interdisciplinary research community across campus. By strengthening collaborations, new ideas could lead to groundbreaking outcomes and students could experience an education rivaled only by a handful of institutions throughout the country. From here, the Interdisciplinary Science Cooperative (IS Co-op) was born.

Launching a collaborative in a brand-new, state-of-the-art facility designed specifically for people to come together during a year like 2020 has been challenging. However, the need for better research outcomes has never been more necessary to our nation as a whole. Research has continued in our labs throughout the year and, thanks to the dedication of our community, connections are still being made, ideas are still being explored, and new methods of learning are still being discovered.

As you'll see throughout this Impact Report, the Co-op has made significant strides during its first year. Thanks to the work being done here, New Mexico is creating the next generation of knowledgeable leaders and innovators of science and technology. The students, faculty and researchers at UNM are now able to learn cutting-edge science in a laboratory setting, work with the best scholars in their fields, and learn what it is to be successful in gaining research contracts in competition with faculty from more elite R-1 research institutions.

By reading further, I hope you will be inspired to join the Co-op in their efforts as it steadily impacts our state and our world. There is power when we all come together – no matter the distance.

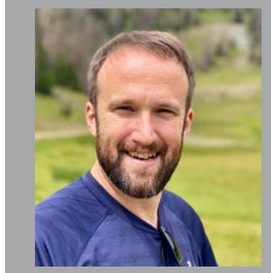
LOOKING FORWARD

Despite its challenges, 2020 has laid the foundation for the future of the Co-op as an engine of cooperation and innovation both at UNM and throughout New Mexico.
Adapting to the COVID-19 crisis forced much of the mission of the Co-op to be advanced virtually, something we will continue to do until we can welcome the broader UNM and New Mexico research community in person, as PAÍS was always intended.

This spring, in cooperation with UNM's Grand Challenges, we will hold our first annual **Team Research Symposium** virtually from April 20 – 22nd. This three-day conference will welcome Science, Technology, Engineering, Art, and Math (STEAM) students and researchers from across campus to come together to learn about one another's research and exchange ideas on how to facilitate more efficient, productive, and harmonious research teams.

This fall, we look forward to hosting our inaugural Open House, which will welcome the broader UNM and New Mexico community to PAÍS in order to learn more about the groundbreaking research and research education being advanced by our resident centers.

Finally, the Co-op will launch its Member Portal in 2021. This free membership is open to anyone interested in engaging with the Co-op and its members; no formal UNM affiliation is required.



2021 will be a year of coming together in a myriad of ways and the Co-op looks forward to facilitating partnerships for the common purpose of advancing human knowledge, research, and training in New Mexico.

Christopher Lippitt, PhD
Faculty Coordinator, IS Co-op

GROUNDBREAKING CEREMONY
March 20, 2018

BEAM RAISING CEREMONY
October 17, 2018

COURTYARD

LOBBY

WELCOME TO PAÍS

The Physics & Astronomy and Interdisciplinary Science (PAÍS) building is a testament to what can be done when people come together towards a common goal. Thanks to the efforts of many dedicated individuals over the past 20 years, including the support of the voters of New Mexico, The University of New Mexico was finally able to execute a longstanding dream of providing our students and faculty with a state-of-the-art facility dedicated to research and education. PAÍS is not only the realization of this dream but the largest investment in science in the state's history, thanks to a GO bond passed by voters in 2016.

In Spanish, the word "PAÍS" means "country." This name was intentionally selected by the Dean of the College of Arts & Sciences, Mark Peceny, PhD, as a way to both honor the University's standing as a Hispanic Serving Institution (HSI) and to serve as a reminder of the power in people coming together. Sitting at the Yale entrance of UNM, PAÍS is a brand-new, 137,000-square-foot collaborative facility standing ready to welcome not just UNM's students, faculty, and staff, but our entire University community. The work being done here by those who are conducting groundbreaking research in our labs, as well as those providing our students with an education that is on par with other top research universities throughout the country, stands to significantly impact the state of New Mexico.

In addition to the classroom and office space within PAÍS, the building offers access to 23 labs with state-of-the-art instrumentation. There is also a high-performance section of the building that was designed to meet very high standards for vibration and electromagnetic interference (EMI) criteria due to the sensitive nature of the experimentation and research that will take place within the labs. The stories within this impact report are a testament to the capabilities that this facility provides to our faculty and students in realizing new outcomes.

PAÍS was built to be shared but unfortunately, due to the COVID-19 pandemic, plans have been put on hold to welcome our external community into the space. As a thank you to the individuals responsible for making this facility a reality, a virtual ribbon cutting ceremony and tour was launched on the Co-op's website on October 2, 2020 and ran through National STEM Day on November 8th.

Viewers of this virtual celebration were treated to a traditional ceremonial ribbon cutting by President Garnett S. Stokes, as well as video tours of our individual labs. These tours gave an up close and personal look at how PAÍS is already expanding the research and educational opportunities on campus. They can still be accessed on the Co-op's YouTube page here.

The day before the public launch, a private screening of this virtual ribbon cutting and tour was attended by 103 VIP guests, including Senators Gerald Ortiz y Pino and Michael Padilla and representatives from both Governor Michelle Lujan Grisham's and Mayor Tim Keller's offices. All shared their support and excitement for this incredible milestone in the University's history.

We are eager to welcome our extended community inside this remarkable facility as soon as it is safe to do so.

THE CO-OP ROOM
The Co-op's largest collaborative space with room for 50 people to share ideas.

THE VISUALIZATION LAB
With 18 4k screens, the Visualization Lab is one of the largest video walls in the country.

THE CO-OP CONFERENCE ROOM
State-of-the-art space that is designed for both in-person and remote meetings.

Center for the Advancement of Spatial Informatics Research & Education (ASPIRE)

Building Community Partnerships

What happens when you involve the general public in capturing research data? The Center for the Advancement of Spatial Informatics Research & Education (ASPIRE), led by Christopher Lippitt, PhD, is working with the U.S. Fish and Wildlife Service (USFWS) and Carinthia University of Applied Sciences in Austria to find out.

Through their partnership, their project titled "Ducks and Drones" is creating a less invasive method of counting and identifying the number of waterfowl in wildlife preserves throughout New Mexico. From images captured by ASPIRE's drones at the Bosque del Apache and Maxwell National Wildlife Refuges, the general public is being encouraged to participate in this research by labeling these images at their SciStarter page. As of this publication, over 22,000 individual labels of birds have been made by users which will provide the benchmark for future waterfowl identification.

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CENTERS AND LABORATORIES REPRESENTING 10 DIFFERENT DEPARTMENTS ARE LOCATED WITHIN THE CO-OP

The ultimate goal of this effort is to build a machine-learning algorithm that can automatically identify birds in drone imagery so that it doesn't have to be done manually. In order to accomplish this, the algorithm needs a library of examples to identify what a duck looks like in comparison to a goose, for example. Citizen scientists are helping researchers build this library while learning about conservation and data science.

ASPIRE is currently working with USFWS outreach coordinators to create learning modules and lesson plans to encourage classrooms around the country to participate in the Ducks and Drones project. They hope to build a broad-reaching education and outreach network that the USFWS can use to engage students on other wildlife and technology related topics in the future.

You, too, can participate by becoming a citizen scientist here. To learn more about the Ducks and Drones project, click here.

In this aerial image, citizen scientists have labeled ducks in red and geese in blue.

Computational Genomics & Technology (CGaT)

Improving Testing for COVID-19

JEREMY EDWARDS, PHD
DIRECTOR, CGAT

Scientists across the country have been working diligently to find solutions to the enormous impact that COVID-19 has made on our lives, and Jeremy Edwards, PhD, Director of the Computational Genomics & Technology (CGaT) lab, is one of them.

This past spring, his lab went to work utilizing his expertise in genome sequencing to devise a new whole viral genome sequencing and testing strategy for the disease — one that could have a significant effect on our future ability to eliminate false negatives, track the progression of the disease, identify new variants, and provide surveillance to prevent the next pandemic.

Our current sequencing technologies are optimized for the human genome and because of this, it is surprisingly expensive and time consuming to sequence a virus. To sequence a virus, you must sequence the whole genome which can take days to do. The benefits of being able to speed up this process are evident: through better tracking we can see how the strain is evolving and potentially save more lives in the process.

Over the past few months, Edwards' lab and collaborators have developed a new chip that does just this. They have not only found a way to sequence the COVID-19 virus more efficiently, but more cost- effectively as well. The virus can now be sequenced in a manner that allows us to eliminate false positives and f ind out if infections are related because the whole viral genome is being tested within a sample.

The virus that causes COVID-19 is not the only genome that Edwards' new technology can sequence. In fact, pathogens to all respiratory diseases have also been included so that new strains can be identified and new treatments can be administered more quickly. With this ability, there is no telling how many lives could benefit.

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STUDENTS WITHIN THE CO-OP ARE GETTING THE OPPORTUNITY TO WORK ALONGSIDE SOME OF THE BEST RESEARCHERS IN THEIR FIELD

Comparative HuMan & Primate Physiology Center (CHmPP)

The Importance of Connections As We Age

Twenty years' worth of behavioral data in chimpanzees has led to a new understanding of how their social interactions later in life mirror those of humans. As social animals, friendships are at the core of both human and chimpanzee life, but the research published in Science by Melissa Emery Thompson, PhD, director of the Comparative HuMan & Primate Physiology Center (CHmPP) and colleagues is the first study of how a psychological theory on aging in humans may also be applied to nonhumans.

Researchers at CHmPP, the University of Michigan, Tufts University, and Harvard University have spent many years working together to study the behaviors of the Kanyawara chimpanzee community in the Kibale National Park in Uganda. Funded by the National Institutes of Health and the National Science Foundation (NSF), their research has tested a fundamental idea in psychology called the "socioemotional selectivity theory". This theory suggests that, as we age, we become increasingly selective over our social networks due to the realization of our impending mortality.

MELISSA EMERY THOMPSON, PHD
DIRECTOR, CHMPP

Through their observations of the Kanyawara chimpanzee community over the past twenty years, researchers found that younger chimpanzees tended to form many one-sided relationships where their partners did not reciprocate. However, as they aged, their bonds with certain chimpanzees grew while their aggressive behavior diminished. This increase in positive relationships is a behavior that psychologists have long argued is due to a conscious awareness over our own mortality as humans age. However, this was the first time that this same behavior was observed in animals.

Chimpanzees may not have the same awareness over their own mortality that humans have, but the research points to a critical shift in alliances that may be the key to understanding how this response benefits them— as well as humans — as they grow older.

$11,780,263

TOTAL AMOUNT OF AWARDS RECEIVED BY OUR LABS IN 2020

Center for Quantum Information & Control (CQuIC)

Quantum Collaborations

IVAN DEUTSCH, PHD
DIRECTOR, CQUIC

Over the past year, the Center for Quantum Information and Control (CQuIC)'s standing as New Mexico's Quantum Information Science (QIS) hub has earned them two separate awards resulting in over 30 collaborations with universities, laboratories, and industrial partners throughout the country — putting them at the heart of the National Quantum Initiative (NQI). Led by Regents' Professor Ivan Deutsch, PhD, CQUIC is poised to expand their standing as leaders within their field.

The NQI act of 2018 was passed by Congress in order to expand the number of researchers, educators, and students with training in QIS, and to promote the further development of facilities and centers available for QIS research.

In 2020, advances were made to bring these goals to fruition with the establishment of new QIS centers sponsored by the National Science Foundation (NSF) and the Department of Energy (DOE). CQuIC is a key participant in two of these new centers: The Quantum Systems through Entangled Science and Engineering (Q-SEnSE) and the Quantum Systems Accelerator (QSA).

Q-SEnSE is one of three $25 million Quantum Leap Challenge Institutes (QLCI) inaugurated by the NSF and led by the quantum initiative at the University of Colorado. Its focus is on the development of next generation quantum sensors and metrology.

The QSA is one of five $115 million QIS-NQI Centers inaugurated by the Department of Energy. Led by Lawrence Berkeley and Sandia National Laboratories, QSA seeks to co-design the algorithms, quantum devices, and engineering solutions needed to deliver certified quantum advantage.

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PUBLICATIONS BY CO-OP FACULTY IN 2020

QIS is a rapidly developing field, one that is profoundly influencing our understanding of the interrelationships between quantum physics and information science. The application of QIS promises radically new technologies in computing, communications, and sensing.

Center for Stable Isotopes (CSI)

Developing New Techniques

In terms of instrumentation, the Center for Stable Isotopes (CSI), led by Distinguished Professor, Zachary Sharp, PhD, is one of the largest stable isotope facilities in the world The capabilities of their new lab have led to some extraordinary collaborations, including their newest one with the National Science Foundation (NSF).

ZACHARY SHARP, PHD
DIRECTOR, CSI

As part of a $900,000 three-year collaborative grant, Sharp and his colleagues are developing a new stable isotope method that requires a single sample to measure water sources. Through this research, they will analyze the amount of water house sparrows, deer mice, and collared lizards need to live while also seeing how reliant they are on different forms of water.

CSI will be responsible for analyzing the data while John Whiteman, PhD, assistant professor at the lead institution of Old Dominion University, will be doing much of the research involving mice, sparrows, and lizards in his lab. Alex Gerson, PhD, associate professor at the University of Massachusetts at Amherst is also lending his expertise in birds to help take this project to the next level. Both are former postdocs of CSI's.

To capitalize on these collaborations, CSI was able to hire Nico Lubcker, PhD from the Marine Mammal Research Institute as a postdoctoral fellow. Lubcker will study metabolism and water efficiency of animals using a new triple isotope technique developed at UNM by Whiteman when he was a postdoc.

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INDIVIDUAL EXTERNAL COLLABORATORS WORKED WITH CO-OP LABS IN 2020

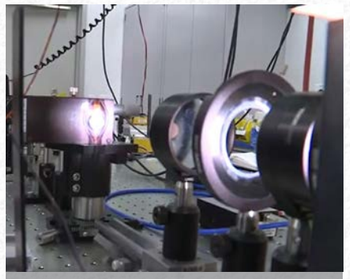
Thanks to CSI's wide range of capabilities, a separate equipment grant has also been funded by NSF which will give the lab the distinction of having the second-ever laser absorption mass spectroscopy system. With this award, CSI will be able to make their measurements more accessible to other labs by using equipment that is smaller and less costly to acquire — ultimately providing the potential to broadly dissemiate the results of this research.

More information on this collaboration can be found here.

Laboratory of Magneto-optical Spectroscopy

Cutting-Edge Education

Right here in New Mexico, students in the Laboratory of Magneto-optical Spectroscopy are being exposed to cutting-edge instrumentation and skills that will put them far ahead of their peers once they graduate. Directed by Jeffrey Rack, PhD, *(pictured above, far right)*, the new lab within PAÍS is now one of few in the world equipped to measure light down to a quadrillionth of a second. With this capability, Rack and his students are increasing their collaborative opportunities and producing measurements so accurate that they are sure to greatly impact future solar technologies.



In a collaborative study with the University of Chicago, graduate student Emigdio E. Turner *(pictured above, third from right)* led the effort by creating a high-sensitivity, low-signal instrument capable of measuring magneto-optical properties of materials that are generally understood to be non-magnetic — or organic — in composition.

While it is not common for these materials to have magnetic properties, researchers world-wide have discovered that some organic materials have enough magnetic properties to produce electricity. Ultimately, this means that solar energy could one day become much more accessible to the general population because organic materials are much less costly to produce.

To help advance this project, graduate student Glorianne Dorce *(pictured above, second from right)* will be working with Emigdio over the next few months in instrument development. Additionally, Glorianne will be monitoring the magneto-optical properties of new hybrid materials.

Technologies for harnessing light can be found everywhere: from cell phone displays, to cameras, to medical equipment. Our world today is largely affected by the many forms of light that power devices for healthcare, energy, education and climate study, to name a few. UNM graduates will no doubt be at the forefront of future advancements in these technologies, thanks to their experiences gained here.

$18,653,358

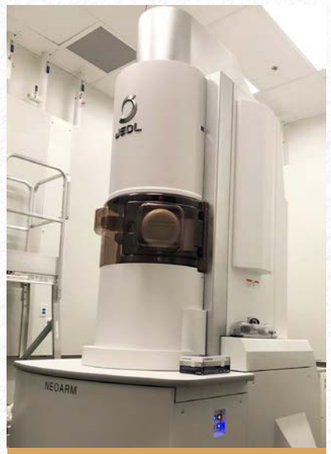
TOTAL AMOUNT OF NEW INTERDISCIPLINARY SCIENCE PROPOSALS SUBMITTED THROUGH THE CO-OP IN 2020

Nanomaterials Characterization Facility (NCF)

Seeing Small to Think Big

Thanks to the state-of-the-art capabilities that PAÍS provides, the Nanomaterials Characterization Facility (NCF), led by Distinguished Professor Adrian Brearley, PhD *(pictured above)*, will soon be one of a handful of labs in the country to house an Aberration Corrected Scanning Transmission Electron Microscope (AC-STEM). The machine, a NEOARM, designed and built by Japanese Electron Optics Limited (JEOL) provides among the highest resolution currently available and as a result, is able to image single atoms, the smallest particles of matter that define the chemical elements.

The implications of this technology are significant since atomic imaging is very challenging and requires an extremely stable instrument within a laboratory space with very sophisticated environmental controls. With the NEOARM, single atoms that could not be resolved using a lower resolution microscope can now be imaged. Chemical compositional mapping is also 20 times faster, which will enable researchers to learn about the relationships between compounds more efficiently and clearly.



The NEOARM can image a single atom

Not only will students be exposed to this incredible new instrument, but the lab will also have the ability to collaborate with other researchers throughout the country in real time, using a live video feed. With this ability, students will graduate from UNM with a significant advantage over most of their colleagues in their field. Additionally, with the expansion of our partnerships, the research being done right here in New Mexico will have the potential to impact the world.

The NEOARM was funded through a $1.75 million Major Research Instrumentation (MRI) program grant through the National Science Foundation (NSF) and funds from UNM. In addition to this, the NCF has also just been awarded a $1 million grant from NASA to Brearley through the Department of Earth and Planetary Sciences that will allow the addition of an electron energy loss spectrometer. This equipment will enhance the NEOARM's already powerful capabilities to realize new relationships within materials at the atomic scale, including single atom chemical analysis.

With the addition of this electron microscope to the NCF lab, UNM is truly leading the way in conducting – and teaching – cutting-edge science.

THE FUTURE OF RESEARCH EDUCATION

The Co-op's first undergraduate research fellowship was made possible by a generous gift from School of Engineering alumnus, Roger Jones, PhD, and his wife, Teri. Through their vision, the Co-op's Undergraduate Fellowship in Water Management was created in order to provide an interdisciplinary research experience that focuses on providing hands-on practice in understanding water resource systems. This experience will culminate in the research and development of a dynamic simulation model that focuses on the issues impacting the middle Rio Grande.

The Jones' were particularly drawn to using an interdisciplinary approach for tackling this issue because of the diversity of stakeholders, stating, "The solution to this problem in New Mexico will provide a template for solving the problem on a global scale."

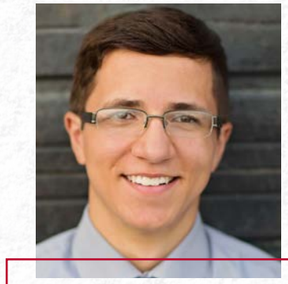
Their experiences in working across disciplines throughout their own professional lives taught the Jones' that "diverse points of view made for robust problem solutions; solutions that came quicker and were better than if we had tried to solve the problem from our limited perspective. That is why, given the opportunity, we sought out the people focusing on interdisciplinary solutions at UNM."

The Jones Interdisciplinary Science Fund, will support three students every year over the next five years in creating a dynamic simulation model that addresses water management issues within the middle Rio Grande. The very first recipients of this fellowship are Sofia Jenkins-Nieto (Environmental Science B.S. candidate, 2022), Atlin Johnson (Civil Engineering B.S. candidate, 2022), and Jewel Yoko Kentilitisca (Population Health B.S. candidate, 2021).

Combined with their shared passion for water sustainability, Sofia, Atlin, and Jewel will also get to learn from one another through their various experiences in social justice, STEM, and community organizing. Their broad range of expertise is a testament to the potential impact that this sort of a collaboration can have in strengthening our communities.

Applications for the Undergraduate Fellowship in Water Management will open in the summer of 2021. More information will be available on the Co-op's website. To contribute to the Jones Interdisciplinary Science Fund, click here.

SOFIA JENKINS-NIETO



ATLIN JOHNSON

JEWEL YOKO KENTILITISCA

THE RIO GRANDE RESEARCH COLLABORATIVE

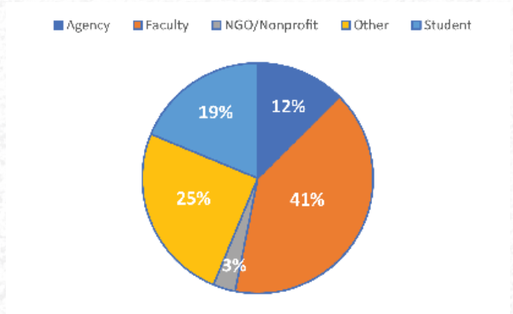
MELINDA MORGAN
DIRECTOR, SUSTAINABILITY STUDIES

Global climate change is having a tremendous impact in the Rio Grande watershed. Average temperatures in the Rio Grande Basin are increasing at a rate of 0.7 degrees Fahrenheit per decade--a rate approximately twice the global average.

These temperatures are pushing the Rio Grande forest systems past an ecological threshold. This transformation will in turn have dramatic implications for downstream water users. The Rio Grande and its tributaries provide water to about half of New Mexico's population, including the downstream communities of Albuquerque and Santa Fe and surrounding agricultural areas.

In the fall of 2020, Melinda Morgan, director of the UNM Sustainability Studies Program, launched a transdisciplinary research collaborative investigating the social-ecological challenges facing our watershed. The Rio Grande Research Collaborative (RGRC) includes a broad cross-section of partners across campus including the Interdisciplinary Science Cooperative, R.H. Mallory Center for Community Geography, Resilience Institute, Center for Water and the Environment, and the Water Resources Program.

To launch the collaborative, a bi-weekly webinar series was held from September through December. The goal was to introduce faculty, student and community partners to the watershed, its challenges, and to the nature of interdisciplinary work. Over seven sessions, 72 attendees were able to learn from experts such as Dagmar Llewellyn of the U.S. Bureau of Reclamation, Collin Haffey of the Nature Conservancy, and Distinguished Professor Barbara Cosens of the University of Idaho, who is an expert in adaptive water governance.



REPRESENTATION OF ATTENDEES

Going forward, the RGRC will develop an ongoing, transdisciplinary research collaborative involving UNM faculty, students at all levels of education, and community members and stakeholders in the watershed. If you are interested in becoming involved, please contact Melinda Morgan.

THE MUSEUM RESEARCH TRAINEESHIP

LEARN

EXPLORE

CONNECT

Beginning this fall, students at The University of New Mexico will be given the opportunity to transcend disciplinary boundaries through a new research program designed specifically to increase diversity within STEM.

The Museum Research Traineeship (MRT) is a collaborative effort among the Museum of Southwestern Biology, the Maxwell Museum of Anthropology, and the Paleobiology Collection in Earth and Planetary Sciences at UNM. Funded by a National Science Foundation Research Traineeship (NRT) grant, over the next five years 75 graduate students and 40 undergraduate students from diverse backgrounds will participate in this interdisciplinary training program that uses UNM's world-class museum collections to investigate cultural, biological, and earth science trajectories and processes at varying spatial and temporal scales. The program focuses on critical contemporary issues, including past and future changes to the global environment and their impacts on human communities and biological and Earth system resources.

"Since 1932, science museums have been at the center of campus life at UNM," said biology professor, Thomas F. Turner, who is also the Curator of Fishes in the Museum of Southwestern Biology, and the Principal Investigator for this project. "The university resisted a national trend of removing museums from campus, and instead made steady investments in infrastructure and hiring research faculty curators and museum professionals. Museums are a vital part of the research, education and public service missions of the university, and this program capitalizes on UNM's long-term investment. NSF recognized the enormous potential for new scientific discovery and student training that our museum-based program offers."

Students will use cutting-edge imaging and material science technology to develop new ways to interpret museum objects, such as biological specimens, pottery sherds, fossils, geological samples, and associated data. The program leverages technical expertise and infrastructure in the Interdisciplinary Science Cooperative, which houses research centers with expertise in geochemistry, genomics, informatics, geospatial analysis, and high-resolution imaging and visualization, and the interdisciplinary expertise of the UNM Museum Studies Program.

For more information, go to mrt.unm.edu.

HOW TO GET INVOLVED

Make a Gift

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Become a Member

Attend an Event

For more information on how to get involved, contact Irene Gray, Program Planning Manager, or go to ISCo-op.unm.edu

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