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Research with NJ Taps University

Montclair State University is among six leading New Jersey universities contributing to “Research with NJ,” a scientific research database created to support the continued development of New Jersey’s innovation economy.

Research with New Jersey was formally launched by Governor Phil Murphy in August and is designed to foster collaboration between business, industry and prestigious New Jersey research institutions by providing free access to institutional research assets in science, technology, engineering and mathematics, or STEM, disciplines.

“As a state-designated public research university and among the national research doctoral universities recognized by the Carnegie Classification of Institutions of Higher Education, research is absolutely critical to our mission,” says President **Susan A. Cole**. “Through the database, the University will be able to share more fully our exceptional research assets and expertise with potential industry and government partners

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Polar Scientist Looks Back To Predict Future Ice Melt



An award from the NSF is supporting Professor Sandra Passchier’s research on the Antarctic ice sheet.

Earth and Environmental Studies Professor Sandra Passchier will use data from millions of years ago to predict Antarctic ice sheet response to global warming.

The Antarctic ice sheet (AIS) covers 5.4 million square miles, or 98 percent, of a continent roughly the size of North America — and Passchier’s research is devoted to exposing the secrets of AIS dynamics. A recent \$323,113 National Science Foundation award supports her three-year project that will help scientists forecast global sea level rise.

A pioneering polar scientist in the field of internationally coordinated Antarctic research, Passchier is currently focusing on West Antarctica, where ice melt has tripled in the past 15 years. “Understanding how the West Antarctica ice sheet responds to global warming is crucial in providing accurate sea level predictions,” says Passchier, who hopes to make her sixth trip to Antarctica in early 2019.

By going back in time to show the effect of greenhouse forcing on ice sheet development, Passchier says her findings will show “how ice sheets and sea level behaved under conditions of higher levels of greenhouse gases in the atmosphere than we have today — levels that are similar to those we will reach in a few decades if these emissions aren’t curtailed or mitigated.”

As a team member on five previous international science drilling programs, she helped extract sedimentary core samples from hundreds of meters beneath the Antarctica sea floor. Now, Passchier — and undergraduate and graduate students — will analyze these and other archived samples to reconstruct the timing and spatial distribution of Antarctic ice growth during

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Improving Retention of New Science Teachers

As the nation faces a pressing shortage of qualified science teachers, University researchers are studying how school districts can retain new teachers.

Department of Secondary and Special Education Chair **Douglas Larkin** and Biology Professor **Sandra Adams** have received a five-year, \$800,000 National Science Foundation award for their project, “Studying the Retention of Novice Science Teachers by Learning from School District Induction and Mentoring Programs.”

The professors will begin by assessing the retention rates of science teachers in the first five years of their careers in New Jersey, North Carolina, Pennsylvania and Wisconsin. “We are specifically looking to investigate the role that induction support during a new teacher’s career has on retention,” Larkin explains. “Our expectation is that districts with higher retention rates are engaged in innovative practices and mechanisms of supporting new teachers that we can then share with a wider audience.”

The team will track multiple teacher cohorts from three groups for five years each: high-need schools and districts in the top 5 percent of their states in terms of retaining new science teachers; schools and



“Our hope is that by identifying successful means of supporting new teachers, we’ll be able to provide districts that aren’t engaged in effective retention practices with a vision for changing their support for new teachers.”

—Douglas Larkin

districts with high retention rates for teachers of color; and Noyce Scholars.

While they are concentrating on science teachers, Larkin notes that the database tools they are developing should ultimately help states track retention rates for teachers in any discipline.

In the first of two phases, the researchers — and doctoral and master’s degree students — will examine school district staffing data to construct a five-year retention

map for the three cohorts. The second project phase will draw on these findings by identifying districts in the focus states with high rates of teacher retention, and conducting site visits to construct case studies of their induction and mentoring programs.

“Our hope is that by identifying successful means of supporting new teachers, we’ll be able to provide districts that aren’t engaged in effective retention practices with a vision for changing their support for new teachers,” Larkin says.

Polar Scientist Looks Back
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the greenhouse-to-icehouse climate change that affected the entire planet 37 to 33 million years ago. The new paleo-climate data will help project the AIS response to continued global warming.

“Current greenhouse gas levels are higher than at any time in human history,” she explains. “To understand this climate state, we need to assess earth processes from millions of years ago and study

the history of the AIS and climate system in the geological archives buried in layers of mud under Antarctica’s sea floor.”

Studying the Role of Protein Aggregates in Alzheimer’s Disease



Professor Ashuwin Vaidya is conducting small-scale mathematical modeling in collaborative research.

While protein molecules frequently clump together to form various aggregates, one such aggregation produces amyloid clumps, which scientists believe play a role in neurodegenerative diseases such as Alzheimer’s.

Vaidya, a Mathematical Sciences professor, has received a National Science Foundation grant of \$111,404 to support his work on “Dynamics of surfactant-amyloid-beta protein interactions during self-assembly,” a three-year collaborative research project.

“We’re trying first to understand the fundamental mechanics of how aggregates and aggregate pathways happen.”
—Ashuwin Vaidya

Vaidya’s team seeks to understand how biological surfactant molecules modulate amyloid protein

aggregation to form specific aggregate species, including the protein amyloid-beta, which is closely associated with Alzheimer’s disease. “Beta-amyloid plaques — a consequence of aggregation — are seen in the brains of Alzheimer’s patients,” Vaidya notes.

“I’m doing the small-scale mathematical modeling, while my colleague at Virginia Commonwealth University is doing larger scale computational modeling and my biochemist collaborator at the University of Southern Mississippi will conduct experiments on the proteins behind all this,” says Vaidya. “Our work feeds into each other.”

This interdisciplinary, synergistic approach unites experimental biophysics, simulation and mathematical analyses to meet two project aims. “We’re trying first to understand the fundamental mechanics of how aggregates and aggregate pathways happen,” says Vaidya, whose funding includes support for a graduate student assistant. “Then we want to see how a system can shift from one pathway to another.”

Ultimately, this fuller understanding of aggregation pathways within a more complex network of reactions involving amyloids could lead to the development of effective intervention strategies — not only for patients suffering from Alzheimer’s disease but also for those with other neurological disorders.

Students Study Urban Stormwater With EPA P3 Grant

A team of undergraduate and graduate students, led by Earth and Environmental Studies Professor Yang Deng, recently received a \$75,000 People, Prosperity and the Planet (P3) grant from the U.S. Environmental Protection Agency (EPA).

By removing contaminants from urban stormwater at their source, the students’ project, “Toward Sustainable Urban Stormwater Management with New, Green, Low-Cost Sorbent-Coated Wood Mulch,” will help shorten water treatment time and make it more efficient to provide clean, safe water.



“Montclair State has long been a leader in New Jersey in the field of environmental science, management and sustainability research,” says **Scott Herness**, vice provost for research and dean of The Graduate School.

“This grant enables our students and faculty to further the work on improving the quality of urban environments by using recycled municipal solid wastes as new adsorbents for removing heavy metal contaminants — such as lead and nutrient phosphorous — from stormwater at its source.”

Waging War Against Antibiotic Resistance

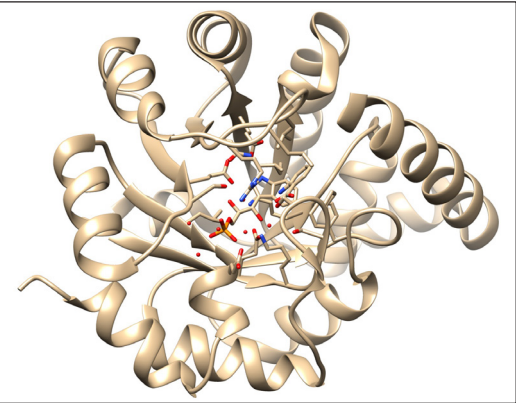
With antibiotic resistance on the rise, it is increasingly challenging to combat bacterial infections.

With support from a \$302,000 National Institutes of Health grant, Chemistry and Biochemistry professors **Nina Goodey** and **David Konas** are studying whether a bacterial enzyme might be a viable target for future antibiotics. The bacterial enzyme IGPS is a

catalyst in the synthesis of the essential amino acid tryptophan. “Tryptophan synthesis in bacteria resembles an assembly line,” explains Goodey. “IGPS is the second-to-last worker in this assembly chain. While we know the structures of the starting material and product of the IGPS reaction, we don’t know exactly how IGPS operates.”

studies of IGPS as an antibacterial drug target,” Konas says.

“When we discover a new target, drug resistance will likely eventually emerge, but importantly, the new target buys time to find other new targets and strategies,” says Goodey. “The situation is like an arms race — and we hope scientists, not bacteria, stay on the winning side.”



Structure of the IGPS enzyme with substrate analog bound in the active site.

Since people — who get their tryptophan from dietary proteins — do not have an IGPS enzyme, Goodey and Konas hypothesize that IGPS could be an effective new target for antibiotics. “We’re excited about the possibility of discovering a compound that will inhibit IGPS with high affinity and allow for

Many steps will be involved to determine IGPS’s value as an antibacterial target. Konas and his lab will make new compounds that will help the team learn more about IGPS, while Goodey’s lab will produce IGPS enzymes, test the effects of small changes to different parts of the enzymes, and test new compounds with the enzymes.

Helping Middle School Students Understand Graphs

STEM-field students of all ages are often challenged to construct and interpret graphs that depict information about two or more covarying quantities.

“One great obstacle to students’ understanding of graphs is that they often haven’t had enough experiences constructing the underlying coordinate systems needed to make sense of graphical representations,” says Mathematical Sciences Professor **Teo Paoletti**.

As the recipient of a one-year award from the Spencer Foundation, Paoletti hopes to remove that obstacle. He will be working directly with sixth-graders to improve their

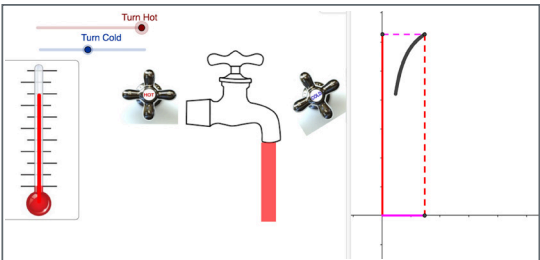
understanding of typical textbook graphs — such as those that show how an object’s position changes over time or how the volume of a gas changes as its temperature rises or falls.

“I’m hoping to design a series of tasks that helps students view graphs as a representational tool that can explicitly help them reason about changing quantities and then consider how they can graphically represent them — first individually and then together,” he explains.

While Paoletti is currently working with two Montclair

State doctoral students on the project, he plans eventually to extend the work to include researchers from Texas State University.

For Paoletti, the prestigious award validates the relevance of his work to the broader community of STEM educators. “I hope I am able to provide important insights that teachers around the world can use in their own classrooms to help their students better understand graphical representations.”



Temperature and flow rate of water at a faucet when hot water is turned on.

Is School Choice Working for Marginalized Students?

Professor Katrina Bulkley is studying how school choice supports the varied and complex needs of students.

While “school choice” can offer students the opportunity to attend schools — such as magnet and charter schools — other than local public schools, it is unclear whether current choice options are significantly improving education outcomes for disadvantaged students.

Counseling and Educational Leadership Professor Katrina Bulkley is a member of a core team of researchers from around the nation that has secured a \$10 million grant from the U.S. Department of Education’s Institute of Education Sciences to explore how school choice is working for minority, low-income, English-language learner, special education and other disadvantaged students. She has received part of \$170,000 sub-award to support her work on the team’s five-year REACH (National Center for Research on Education Access and Choice) project.

“This center goes far beyond asking questions as to whether different forms of choice policies are good or bad,” Bulkley says. “Instead, we’re asking how school choice — alongside other changes in policies and practice — can best be utilized to support the varied and complex needs of students from historically marginalized populations.”

While Bulkley is involved in the overall qualitative research in nationwide locations that connects



We’re asking how school choice — alongside other changes in policies and practice — can best be utilized to support the varied and complex needs of students from historically marginalized populations.”

—Katrina Bulkley

with the project’s five “policy levers” — planning and oversight, transportation, enrollment systems, information and teachers — she will focus specifically on the District of Columbia and Florida.

She is also co-leading the team’s study of the authorizers who approve and oversee charter schools. “Since many charter schools serve students and families from critically underserved groups, understanding the role of authorizers overall and in serving these groups is especially important as the reach of charter schools grows.” Bulkley notes that University students will be

involved in analyzing charter school applications.

Bulkley expects the team will uncover specific contexts where choice is related to a positive impact on disadvantaged students. “For example, high-quality authorizing practices may be connected to higher-quality schools,” she explains.

After five years of study by REACH, Bulkley anticipates that, “policy makers at all levels will have access to concrete research-based policy practices and that some of them will act on those recommendations.”

SPOTLIGHT: News Briefs

Fast Start for Grants

For the first quarter of fiscal year 2019 — from July 1 through September 30, 2018 — Montclair State researchers have received \$5.3 million in externally sponsored grants and contracts.

“Montclair State’s steady increase in extramural funding is a true testament to both the growth of our research enterprise as well as the strength of our research faculty,” says Vice Provost for Research and Graduate School Dean **Scott Herness**.

“The breadth of our funding portfolio — from educational assessment to astrophysics — is exactly what one would expect at a nationally designated doctoral research university,” Herness says.

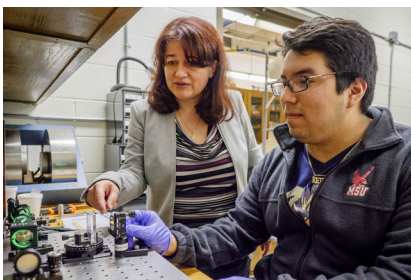
“Our continued increase in funding from such competitive federal agencies, as the National Science Foundation and the National Institutes of Health, illustrates the high quality of the work done by our researchers and their doctoral students,” he says.

In fiscal year 2018, Montclair State received 84 grants totaling nearly \$18 million from a diverse group of federal, state, local, private and international sources.

Finding the Most Distant Black Holes

Rodica Martin, a professor in the newly launched Department of Physics and Astronomy, is a member of the celebrated international LIGO — Laser Interferometer Gravitational-Wave Observatory — team that confirmed Einstein’s theory of relativity by detecting black hole collisions and neutron star mergers.

She has recently received a \$90,000 National Science Foundation grant to study the optical properties of materials that can be used to develop the next generation of gravitational-wave detectors.



Professor Martin in her optics lab.

Martin’s research will focus on exploring new magneto-optical materials for the detectors’ Faraday isolators. “This grant will allow me to deepen my studies

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High-Tech Way to Test Water

With help from a \$192,212 National Science Foundation grant, Montclair State professors are purchasing a Dynamic Imaging Particle Analyzer (DIPA) that will help them image, count and characterize particles from pollutants to algal cells that can degrade water quality — and harm people and aquatic life.

“The DIPA will let us process samples much more efficiently,” says **Meiyin Wu**, biology professor and director of the University’s Passaic River Institute.

Wu, a project co-principal investigator with Earth and Environmental Sciences Professor **Yang Deng**, notes, “Currently, we process samples under a scope, which can take about three hours for a single sample. Now, it will only take about 10 minutes.

With its accurate, rapid analyses, the DIPA will be a core instrument for critical University research initiatives focusing on developing innovative water treatment technologies for the removal of water pollutants, as well as for identifying and characterizing freshwater algae.

Database Tracks Early Caribbean Census

History Professor **Julia Landweber** has received funding for a June 2019 residence at Brown University’s John Carter Brown Library for ongoing collaboration with Elizabeth Heath of Baruch College–CUNY to create a digital

database focusing on the human populations — both free and enslaved — and agricultural production of early modern French Caribbean colonies.

By digitizing and linking census data to interactive digital maps, it will be possible for the first time to depict the development of multiple commodities across

space and time in the early modern Caribbean.

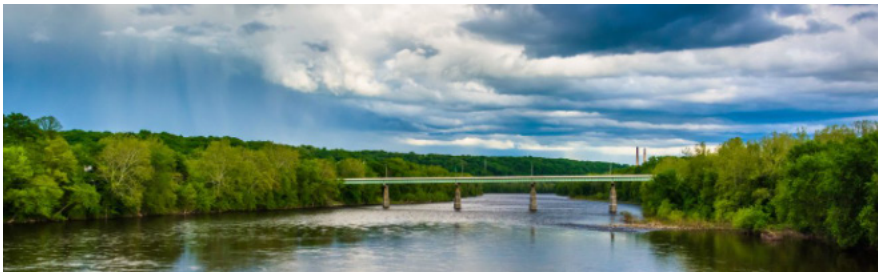
“Our database will be a useful resource to both scholars and students, offering scholars an unprecedented opportunity to use GIS (Geographical Information Systems) tools to analyze demographic, economic and social trends in these colonies.”

Destroying a Dam — and Restoring an Ecosystem

University researchers are monitoring how the removal of the Columbia Lake Dam will help restore the Paulins Kill to health.

“Water quality will be improved,” predicts Montclair State Earth and Environmental Studies Professor **Joshua Galster**, who is measuring the impact of the dam’s removal on the Paulins Kill ecosystem together with Sustainability Science major Carolina Lemanski. “Fish passage and habitat will be improved. The dam is about a quarter mile upstream from where the Paulins Kill meets the Delaware, so we hope fish like shad will swim upstream once the dam is removed and the river is restored.”

“It is a special kind of satisfaction to know that after more than 100 years and \$8 million, American shad will no longer bump their noses on the Columbia Dam when they return to spawn and people will have a cleaner, healthier waterway for recreation,” says Barbara Brummer ’68, The Nature Conservancy’s NJ State Director and Montclair State College of Science and Mathematics Advisory Board Chair.



“It is a special kind of satisfaction to know that after more than 100 years and \$8 million, American shad will no longer bump their noses on the Columbia Dam when they return to spawn.”
—Barbara Brummer

Galster welcomes the opportunity to be part of the dam removal project. It began in July and involves The Nature Conservancy, the New Jersey Department of Environmental Protection, the United States Fish and Wildlife Service and others.

Galster and Lemanski are mapping the depth of the Paulins Kill riverbed along six river cross sections located between the dam and the Delaware River. They will ultimately compare measurements taken before and after the removal of the dam to assess changes in

river depth. “We’re looking to see if there is change — either erosion or deposition — during different stages of the dam removal process,” says Galster, who hopes the project will extend through next year and engage additional student researchers.

According to College of Science and Mathematics Dean **Lora Billings**, the researchers’ work could also have potentially far-reaching implications. “Their expert analysis may provide the scientific basis for decisions about future dam removals.”

Research with New Jersey
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in the search for solutions to today’s most pressing societal and scientific issues and in applications of new knowledge.”

The portal showcases abstracts of published research from Montclair State, the New Jersey Institute of Technology, Princeton, Rowan, Rutgers and Stevens Institute of Technology. Vice Provost for Research and Graduate School Dean **Scott Herness** sits on the Advisory Board, which provides

oversight, guidance and insights for maintaining the portal’s success. “Research with NJ reflects the state, national and international impact of the University’s outstanding research efforts,” Herness says. “For entrepreneurs and industry innovators, it is an efficient way to connect with the cutting-edge institutional research breakthroughs that lead to the creation of new products — and bolster the state’s reputation as a national leader in innovation.”

Finding The Most Distant Black Holes
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in new areas that contribute to increasing the sensitivity of future detectors,” she says.

“With more sensitive instruments, LIGO can detect gravitational waves from sources that are much further away, or that are too weak to observe with current detectors, giving us new insights into the dynamics of the cosmos.”

A Grand Opening for High-Tech Center for Computing and Information Science

The new Center for Computing and Information Science celebrated its grand opening on October 17. The ribbon-cutting ceremony featured a welcome from President **Susan A. Cole**, as well as remarks from College of Science and Mathematics Dean **Lora Billings**, Department of Computer Science Chair **Constantine Coutras** and graduate student **Tori Zirul**.

The result of a \$22.2 million renovation and expansion of the former Mallory Hall, the new 43,800-square-foot facility houses the Department of Computer Science, as well as the College of Science and Mathematics Student Success Center, Mathematics Education group, Health Careers and Upward Bound programs.

“The new Center will allow Montclair State, New Jersey’s second-largest university, to sustain and grow high-quality, high-demand science programs that are directly aligned with the state’s and our students’ needs,” says Billings. “Our College’s programs focus on core and competitive areas of STEM education. To teach students these 21st-century skills, you need a 21st-century facility.”

The opening included a keynote address by alumnus Anthony J. Scriffignano ’82, ’85 MA, PhD,



Cutting the ribbon are, from the left, Keynote Speaker Anthony Scriffignano, University board member Francis Cuss, Susan A. Cole, Lora Billings and Constantine Coutras.

senior vice president and chief data scientist at Dun & Bradstreet, on “Leading Science and Technology in the Face of Digital Everything.”

The renovation project transformed existing classroom and laboratory spaces and added a fourth floor to accommodate the thousands of students who take courses and pursue degrees in computer science and information technology.

The Center features a 145-seat amphitheater; six smart teaching labs and classrooms; a specialized computer hardware lab; nine state-of-the-art research labs; as well as inviting lounge and study areas.

University strategic partner Sony Electronics has delivered a mix of classroom technologies, active learning solutions and state-of-the-art professional equipment from laser projectors to robotic pan/tilt/zoom cameras in collaborative spaces.

A second-floor skyway connects the Center to neighboring Schmitt Hall, providing high-tech common areas designed to promote creativity and collaboration, while expanded research spaces will allow the Department of Computer Science to offer new graduate degrees — including an MS in Cybersecurity and an MS in Data Science.

Building on a distinguished history dating back to 1908, Montclair State University is a leading institution of higher education in New Jersey. Designated a Research Doctoral University by the Carnegie Classification of Institutions of Higher Education, the University’s 11 colleges and schools serve 21,000 undergraduate and graduate students with more than 300 doctoral, master’s and baccalaureate programs. Situated on a beautiful, 252-acre suburban campus just 12 miles from New York City, Montclair State delivers the instructional and research resources of a large public university in a supportive, sophisticated and diverse academic environment.



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