The global eradication of infectious diseases through vaccination and quarantine programs is an increasingly pressing contemporary public health objective. Mathematical Sciences professors Lora Billings and Eric Forgoston are pursuing that goal with the help of a Civil, Mechanical and Manufacturing Innovation grant from the Directorate for Engineering at the National Science Foundation.

The two professors recently received the three-year grant to support their exploration of the dynamics of stochastic (random) disease spread in metapopulations. “We’re looking to determine the conditions for the outbreak, spread and extinction of an infectious disease in randomly connected population networks,” says Billings.

The team will develop new mathematical models that will ultimately help scientists predict the outbreak of a disease, control its spread and develop effective strategies to eradicate it.

The professors have two goals: “First, we want to study and understand the spontaneous extinction of a disease in local populations,” explains Forgoston. “Second, we want to design controls that can facilitate extinction.”

Montclair State students are assisting in this multidisciplinary research with one doctoral student and one master’s student assigned for the duration of the grant. In addition, the team has applied for more funding to support two undergraduate students each summer. “Some students will work on the mathematical analysis of disease models. Others will confirm their work numerical results,” Forgoston says. “Student work will certainly contribute to the goal of describing how a disease can fade out in a network of populations.”

The group’s research has the potential to save lives the world over. Says Forgoston, “We want to optimize vaccine usage to eradicate disease in a given population.”
Breast and cervical cancer are among the most prevalent cancers for women in the United States. Breast cancer accounts for 30 percent of all cancers and 26 percent of cancer deaths, while cervical cancer is the 13th leading cause of cancer for women. Although both cancers can be detected early through screenings, disparities exist among racial and ethnic groups when it comes to taking advantage of such prevention tools.

Stephanie Silvera, associate professor in the Department of Health and Nutrition Sciences, is exploring the socioeconomic, demographic and behavioral factors that create this situation with the help of a $500,000 career development award from the National Cancer Institute. “Non-Hispanic black women tend to have lower rates of breast cancer compared to non-Hispanic white women, but they are more likely to die from it,” notes Silvera. “Also, non-Hispanic black and Hispanic women have higher age- and stage-adjusted cervical cancer mortality rates, compared to non-Hispanic white women.”

According to Silvera, these disparities are explained, in part, by unequal access to cancer screening across socioeconomic and racial groups, but there is also a need to know more about how socioeconomic and demographic differences affect cancer prevention behaviors as well as the perception of access to cancer screening.

Researchers hope to better understand why some groups are at higher risk for the same disease outcomes, particularly when genetics can’t fully explain those differences.

“Non-Hispanic black and Hispanic women have higher age- and stage-adjusted cervical cancer mortality rates, compared to non-Hispanic white women.”

“New Jersey has one of the highest cancer rates in the nation so it’s important to have a better understanding of these disparities.”

– Stephanie Silvera

are searching for an explanation for why the Mars magnetized regions are so much stronger than their counterparts on Earth, and what that means in terms of the intensity of the ancient field.”

The Mars Global Surveyor (MGS) mission found that, similar to Earth’s crust, much of the southern hemisphere of Mars, a region called the Southern Cratered Highlands, has regions that are magnetized. The presence of magnetized regions of crust on Mars surprised scientists, Brachfeld says, because the planet no longer has a magnetic field. “Our results indicate that Mars’ former magnetic field reversed just as Earth’s field does, but the Martian magnetic field has since shut off,” says Brachfeld.

Without its magnetic field, Earth’s atmosphere could be eroded away by solar wind and radiation, as is the case on Mars.

The researchers are asking the following questions: How strong was Mars’ magnetic field? What was its shape? When and why did the field shut off? Will Earth’s field eventually shut off as well? “The satellite data is fascinating,” she says. “The MGS data indicate that the magnetic signal in the Mars Southern Cratered Highlands dwarfs magnetized regions on Earth.”
Sustaining Economies with Biofuels

Along with colleagues from Texas A&M, Virginia Tech and Tuskegee University, Assistant Professor Pankaj Lal recently began work on a three-year project funded by the U.S. Department of Agriculture that assesses the socioeconomic impacts of forest biomass-based biofuel development in the rural South. Their findings will help to develop policies for enhancing rural economies in the thirteen southern states known as “the wood basket of the world.”

“‘I’ll be focusing on sustainability, marketing and policy aspects of advanced biofuel production,” explains Lal. “I’ll estimate net greenhouse gas emissions and assess the economic viability of biofuel production under different scenarios.”

“My hope is that counties identified as persistently poor which are adjacent to forest lands would benefit from the development of a woody bioenergy industry,” says Lal, who teaches in the Department of Earth and Environmental Studies. Doctoral student Bernabas T. Wolde will help Lal collect and analyze data, as well as prepare journal manuscripts.

Lal is also involved in the new Joint Clean Energy Research and Development Center, a U.S.-India initiative committed to advancing clean energy technologies. As co-project director of a consortium led by the University of Florida—one of three consortia funded by a $6.25-million grant from the U.S. Department of Energy—he will identify sustainability indicators for advanced biofuel production from sorghum and switch grass in the United States.

“I’ll be focusing on sustainability, marketing and policy aspects of advanced biofuel production,” explains Lal. “I’ll estimate net greenhouse gas emissions and assess the economic viability of biofuel production under different scenarios.”

“When completed, the project will provide a working model for advanced biofuel production and supply with environmental and economic benefits.” –Pankaj Lal

Studying the Jellyfish Invasion

In the last couple of years, millions of jellyfish have invaded New Jersey’s Barnegat Bay, leading biology professors Paul Bologna and Jack Gaynor to study their potential impact to aquatic food webs.

Funded by the New Jersey Department of Environmental Protection, the researchers will study the effects that the jellyfish—technically known as sea nettles—are having on the bay’s ecosystem. One effect is clear: The sea nettles are now a major nuisance to humans in this heavily populated area of the Jersey Shore. “They’ve become a real problem,” says Bologna, director of Aquatic and Coastal Sciences for the Department of Biology and Molecular Biology. “The sea nettles are literally chasing beachgoers out of the water.”

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Keeping Soldiers Safe with Memory

“We are looking at how novel physiological markers might predict performance on various cognitive tasks—like remembering place names and locations.” – Ruth Propper

Associate Professor of Psychology Ruth E. Propper is working to save soldiers’ lives. Her research with the United States Army could help keep soldiers safe in the field by improving both their memories of place names and locations in unfamiliar terrains and their navigation skills in similar areas.

Funded by a three-year U.S. Department of Defense contract, Propper’s work builds on findings published in the February 2012 issue of Brain and Cognition that focus on how unilateral gaze (looking in one direction) increases geographical memory of the 50 United States. College students were tested to determine whether the left or right brain hemisphere—or a combination of both—retrieves language-based and location-based memories.

“In practical terms, this means if you can’t remember where you parked your car, our study suggests you could look to the left to activate the right side of your brain’s spatial processing superiority or possibly look to the right to trigger the left side of the brain’s verbal labeling superiority and retrieve that memory,” Propper explains.

“We are looking at how novel physiological markers might predict performance on various cognitive tasks—like remembering place names and locations. We’re also looking at new ways to improve performance by altering physiological activity,” she says. “Unilateral gaze is one way we investigate this. Another is to study unilateral muscle contractions to see if they might activate brain areas involved in memory retrieval.”

“Studying the Jellyfish Invasion”

There are several reasons for the sea nettle population explosion and they all stem from the changes occurring in and around the bay. As more people build homes in the area, increased nitrogen is in the water—caused by runoff from lawn fertilizer and acid rain created by increased burning fossil fuels. More nitrogen creates algae blooms that lower the oxygen levels.

Aquatic species that can’t survive in low-oxygen environments are driven away allowing sea nettles, which are not affected by these conditions, to flourish. “Because sea nettles are adapted to low oxygen conditions, they can survive where other organisms cannot,” says Bologna. “Basically, they are winners by default.”

Also working in the sea nettles’ favor is the increase in floating docks, bulkheads and other hard surfaces that come with development. These hard surfaces provide a perfect place for sea nettle larvae to settle and develop into polyps, a critical stage in its life cycle. The polyps can bud, creating more of themselves, adding to the eventual increase in the number of adult sea nettles. As adults, sea nettles are top predators of zooplankton and fish larvae, further depleting populations of other aquatic species.

“Our research will involve field sampling to assess the distribution of zooplankton and the settling of the sea nettle polyps as well as assessing the diets of the sea nettles through dissection and molecular analysis,” says Bologna.
With the help of a grant from Microsoft, Montclair State researchers hope to play a pivotal role in bringing an end to the online sex trafficking of children. Montclair State School of Business researchers Nicole Bryan, Ross Malaga and Sasha Poucki will study the role technology plays in the crime, which along with other forms of human trafficking, has become the world’s fastest growing criminal industry, according to the U.S. Department of Health and Human Services.

In June, the Microsoft Digital Crimes Unit and Microsoft Research awarded the grant to fund a yearlong study focusing on understanding the mindset, vocabulary and search patterns of “johns” who use networked technologies like the Internet, cell phones and social media to sexually exploit children. Bryan, assistant professor of management; Malaga, department chair and professor for information and operations management; and Poucki, a post-doctoral fellow and adjunct professor, will explore how johns search for and find online victims, as well as create networked communities.

“Our eventual goal is to develop disruptive interventions,” says Malaga. “If, for example, we find that search engines are used to find sites advertising sex workers, the search engines could remove those sites or even redirect anyone who clicks on them to a law enforcement page.”

The team, which includes a researcher from the Center for Court Innovation, brings a multidisciplinary perspective to the project. “We’re asking the big questions,” says Bryan, who is leading the interview process. “We want to know how this internal community works and exchanges information.”

The team hopes to recruit as many as 100 johns for the project. “Finding johns who are willing to participate in the study is the hardest part of the research,” Malaga points out. An information technology and search expert, Malaga is helping to developing the interview questions and analyze data. “Once we have data, we will use graduate assistants to help us analyze it,” he explains.

Other University students have expressed interest in working on the project. “We may find a role for students from different departments, including Justice Studies. We’re also thinking of organizing a club around this topic,” says Bryan.

Human sex trafficking ranks alongside trade of illegal arms as second only to drug dealing in international crime, says Rane Johnson-Stempson, the principal research director for education and scholarly communications at Microsoft Research Connection. “The Montclair State team’s research will yield valuable insights into the role technology plays in child sex trafficking, and we are excited to collaborate with them.”

Researchers hope the technologies that the perpetrators use themselves ultimately defeat them. “Our goal is to understand how the process works among johns who exploit minors,” says Bryan. “Our team’s overall mindset is that technology is the tool that will win this fight.”
**Spotlight: News in Brief**

**Predicting Relationship Success**

For nearly 20 years, Constance Gager, family and child studies professor, has drawn on the National Survey of Families and Households to explore marital relationships, focusing on whether couples’ perceptions of the division of household labor, sexual frequency and relationship, happiness and conflict predict the likelihood of divorce. Gager’s recent study conducted with Scott Yabiku of Arizona State University, for example, found that husbands and wives who spend more time on housework enjoy more frequent sex. “We concluded that couples who work hard also play hard,” Gager says. “These couples may be tapping into an underlying trait of being high-energy go-getters.”

Most recently, with grant funding from The National Institute for Child Health and Human Development, Gager has collaborated with Yabiku as well as Family and Child Studies department colleague Miriam Linver to examine the long-term effects of parental conflict on adult children’s relationship success. Their research suggests the idea that parents should not stay together for the sake of the children—at least when there is a lot of parental conflict. “Long-term exposure to parental conflict is more detrimental to children’s adult relationship outcomes than divorce,” Gager says.

**Center for Autism and Early Childhood Mental Health Receives $1.5 Million State Grant**

With one child in 49 diagnosed with Autism Spectrum Disorder in New Jersey, autism has become an epidemic. New Jersey’s First Lady Mary Pat Christie and Health and Senior Services Commissioner Mary E. O’Dowd visited campus in June to announce a five-year, $1.5-million grant for the University’s Center for Autism and Early Childhood Mental Health to establish the New Jersey Autism Center of Excellence and coordinate statewide research and treatment.

“We’ve assembled a terrific team of faculty and staff from across the University that will take a collaborative, multidisciplinary approach to coordinating project support for the Center, the clinical research sites and advancing its initiatives,” says Gerard Costa, director of the Center for Autism and Early Childhood Mental Health.

**The Art in Science**

Physics Professor Ashwin Vaidya and Mathematics Professor Mika Munakata are exploring the connection between creativity and scientific success. In a recent study, they found that university students tend to rank the sciences among the “least creative” subjects.

Their research led to building a course in creative thinking and to a grant from the American Physics Society to fund two projects: “The Art of Making Science,” a joint project between the College of the Arts and the College of Science and Mathematics, and “The Science of Making Art,” a collaboration between the University and the Liberty Science Center, which will result in an interactive exhibit about the relationship between the two disciplines.
Cleaning up Groundwater

Nearly half of the drinking water flowing from taps in the United States comes from wells, so what's in it is vitally important to the health of those who drink it. Yet groundwater supplies have been contaminated by chemicals, heavy metals and other toxins, primarily through the improper storage or disposal of industrial chemical waste.

Researchers at Montclair State have received a grant from DuPont for a 2 1/2-year study to develop a new groundwater remediation method.

Developing new, innovative and environmentally sustainable, “green” solutions to contamination problems is a specialty for Dibyendu Sarkar, professor of earth and environmental studies and director of the doctoral program in environmental management, and fellow researchers Yang Deng, a professor with the Department of Earth and Environmental Studies, and Sudipta Rakshit, a post-doctoral fellow.

Together, the three proposed a study to use ferrate(VI), a form of iron, to treat groundwater contaminated with Freon®. Ferrate is used to treat drinking and wastewater but applying it to groundwater remediation is new. “We knew that there were many other oxidants that people were using quite frequently but no one was using ferrate,” says Sarkar.

Ferrate is also environmentally friendly, sustainable and fast acting. “Iron is the fourth most common element in the earth’s crust,” notes Deng. “It’s non-toxic so we can use it anytime, anywhere.” And thanks to a ten-fold reduction in the price of ferrate(VI) in recent years, the team’s proposal is cost effective when compared with traditional remediation methods. Says Sarkar, “We’ve done preliminary studies, and we are confident that this is going to work.”

Ferrate is a powerful oxidizer that breaks down toxic compounds and eventually becomes harmless rust. “A site treated with ferrate, will go from toxic to less toxic, and from less toxic to non-toxic,” says Deng. “After oxidation, it becomes iron rust and rust is an excellent adsorbent to adsorb heavy metals such as arsenic or mercury from the groundwater.”

Making a Good Argument

To meet recently adopted national education standards, students need to be able to comprehend and formulate arguments—a concept known in teaching as “argument literacy.” Researchers at Montclair State, with the help of a grant from the U.S. Department of Education, are developing a program with Ohio State University to teach students how to properly make and understand arguments.

The three-year professional development project will use participants from a suburban school district in Ohio and an urban district in New Jersey to ensure that the teaching skills will work in both settings, says Montclair’s Professor Alina Reznitskaya, who teaches educational foundations. National education standards define argument literacy as a fundamental life skill “for the literate, educated person living in the diverse, information-rich environment of the 21st century.”

“We plan to draw on contemporary theory and research that suggest that the development of argument literacy is best supported through dialogic teaching—an approach that capitalizes on the power of conversation to further students’ learning,” Reznitskaya says.
Cases of child abuse often turn on the eyewitness testimony of children. Sometimes that testimony is unreliable—not because children lie but because they misremember events or their memory has been shaped by questioning meant to elicit the truth.

Montclair State University researchers are in the middle of a three-year project funded by the National Science Foundation, that could help investigators better interview children and understand how the use of body diagrams in forensic interviews influences children’s reports.

Perhaps the most famous example of how questioning can change memory is the 1980s McMartin preschool case, in which, after seven years of trials without a conviction, the accusations of dozens of children were determined to be false memories created during repetitive interviews with suggestive interviewing techniques.

“The information we’re gathering will influence state- and national-level interviewing practices as well as the content of training for professionals who investigate crimes against children and other vulnerable groups,” says Associate Professor of Psychology Jason Dickinson, who is leading the Montclair State team in a collaborative study with a research team at Central Michigan University.

The team uses an undergraduate assistant named “Mr. Science, Germ Detective,” who, while conducting germ education activities, twice touches the children in innocuous ways such as shaking hands. Prior to the session, children are told that Mr. Science can’t touch them because he might spread germs. He uses “Glo Germ,” that glows under a black light to illustrate how germs spread.

A week later, researchers ask parents whether their children mentioned the touching. Children who did are considered “disclosers;” those who didn’t are “non-disclosers.”

“It is possible that because disclosers have previously reported touching they are more resistant to suggestion in a subsequent interview.”

Using this paradigm, Dickinson’s team is testing how body diagrams—two dimensional human outline drawings—affect children’s reports of touching. His previous research has found that diagrams elicit more false reports of touching. Now they are studying whether using diagrams at the end of the interview minimizes false accounts. “We are finding ways to maximize the accuracy of their reports and minimize errors to help the justice system identify the guilty and exonerate the innocent.”

Dickinson displays “Glo Germ”