GEORGE MASON UNIVERSITY

Where Innovation Is Tradition

Periodic Elements

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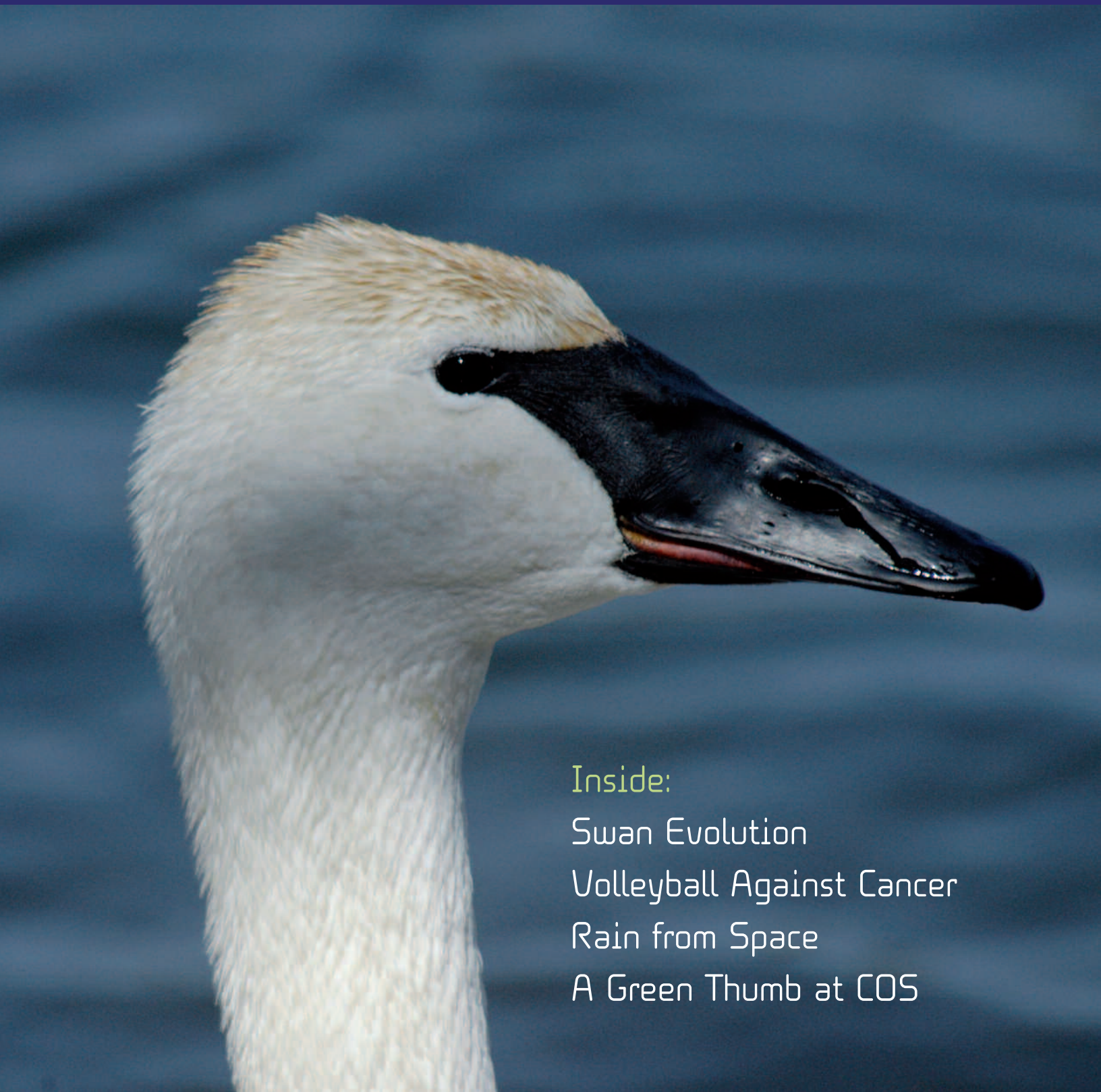

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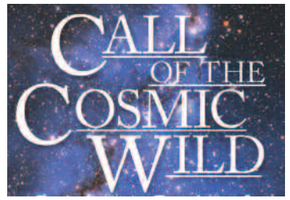

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On the cover

A trumpeter swan at Environmental Studies on the Piedmont near Warrenton, Va., is part of ongoing research into the effects of climate change on evolution.

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Photo courtesy of Patrick Gillevet

Molecular Research Explores New Breast Cancer Treatments

When Lance Liotta and Emanuel Petricoin cofounded the Center for Applied Proteomics and Molecular Medicine (CAPMM) in 2005, they made a commitment to implement breast cancer clinical trials that would take game-changing ideas and cutting-edge therapies directly to patient care. And they've kept their word. Working with scientists, surgeons, and oncologists at cancer treatment centers in Northern Virginia and around the country, they have developed clinical trials that address breast cancer from different perspectives.

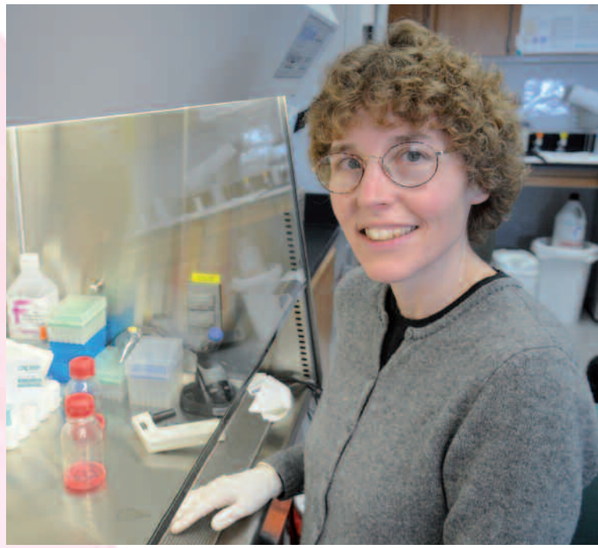
PINC is More than a Color

Ductal carcinoma in situ (DCIS) is the most common type of noninvasive breast cancer, accounting for one-fifth of breast cancer diagnoses made each year. CAPMM scientist Virginia Espina leads a clinical trial that investigates a novel treatment for DCIS that may result in a new method for preventing invasive breast cancer. Her proposal was selected for presentation at the American Society of Clinical Oncology's 2012 Breast Cancer Symposium in San Francisco, Calif.

In the Preventing Invasive Neoplasia with Chloroquine (PINC) Trial, premalignant lesions are treated with chloroquine, a drug used to treat malaria since the 1940s. Funded by the U.S. Department of Defense Breast Cancer Research Program, the trial is based on earlier studies led by Espina that suggest that genetic changes in premalignant lesions can cause them to produce invasive cancer cells.

"Think of filling up a cookie jar," Espina explains. "A process called autophagy works in the same way, building up energy in the cell — like adding cookies to a jar — for future growth. In a cancer cell, we need to find a way to block the process and prevent the cancer from growing and invading healthy cells." Espina and her team think chloroquine can block autophagy by changing the cellular environment to stop cell growth.

"Comparing the lesion before and after therapy will indicate how the lesion responds to chloroquine," says Espina. "After surgery, tissue studies will provide more information about the pathology of the lesion and help us understand how individual lesions respond to treatment. Our overall goal is to find a short-term, nontoxic therapy that can kill the premalignant lesions to stop breast cancer before it starts."



Virginia Espina

Photo: Creative Services

Volleyball Supports the War on Metastatic Breast Cancer

Of the estimated 2.6 million breast cancer survivors in the United States, about 160,000 live with metastatic disease, cancer cells that spread to distant parts of the body through the bloodstream or lymphatic system. Metastasis is the major cause of pain and death from cancer. For the past few years, The Side-Out Foundation, a Northern Virginia organization of individuals who share a love of volleyball and a passion to fight cancer, has supported CAPMM's one-of-a-kind, personalized metastatic breast cancer trial.

"In this study, we're looking at tumors at the molecular level to find potential drug targets and treatments that are individualized to the patient's disease," says CAPMM researcher Mariaelena Pierobon, who oversees the trial. "We're striving to offer immediate help to patients who have few treatment options left."

Later this year, the trial will incorporate genomic studies of cancer cells to determine how mutations affect cellular responses, in addition to molecular analysis, and attempt to develop a complete picture of cellular activity. "We're excited about the next phase of the trial," adds Pierobon, "which will help us determine a patient's personal profile for drug response and incorporate new agents for treatment."

National Collaboration Selects CAPMM for Molecular Analysis

CAPMM is one of a few laboratories nationwide selected to perform analysis of biopsies from early-stage breast cancer patients in the I-SPY 2 clinical

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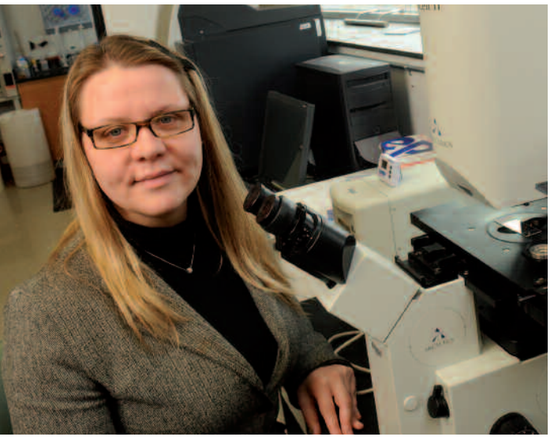

Photo: Creative Services

Mariaelena Pierobon

***Cancer Treatments**, from page 2*

trial based at the University of California, San Francisco. The work, performed using the reverse phase protein microarray technology invented and patented by CAPMM scientists, is supported locally by The Side-Out Foundation. Other partners in this public-private collaboration include the Foundation for the National Institutes of Health, the U.S. Food and Drug Administration, the National Cancer Institute, and the Safeway Foundation.

I-SPY 2 combines personalized medicine with traditional and investigational drug therapies. Patients are randomized to specific drugs based on a variety of factors and receive chemotherapy before surgery to reduce tumor size. Molecular analysis of tissue samples will provide an overview of patient drug responses and indicate which patients benefited from new therapies.

"With goals of testing multiple drugs and developing new ones faster, molecular analysis of a tissue sample will tell us which proteins, or drug targets, are activated in the cell, allowing us to rule out ineffective treatments more quickly," says Julia Wulfkuhle, CAPMM research professor and coordinator of the center's efforts in I-SPY 2.

Research Partnerships Investigate New Possibilities

Liotta's and Petricoin's commitment doesn't end here. Work with The Side-Out Foundation will continue to explore new approaches to patient care, and a grant from Susan G. Komen for the Cure will fund a multicenter collaboration to investigate the role of calcium in cancer cell survival. CAPMM's outstanding reputation for innovation continues to invite progressive research partners in science and medicine.

Photo: Creative Services

Julia Wulfkuhle

Periodic Elements

Q&A

The Side-Out Foundation

Periodic Elements talks with Bryant Dunetz, Chief Operations Officer of The Side-Out Foundation, a nonprofit organization based in Northern Virginia that supports breast cancer awareness, education, and patient services. Side-Out is a generous supporter of breast cancer trials developed by the Center for Applied Proteomics and Molecular Medicine (CAPMM).

PE: What was the pivotal event behind the creation of The Side-Out Foundation in 2004?
Dunetz: The pivotal event and inspiration came from my youngest son, Rick, when my wife, Gloria, had a recurrence of breast cancer seven years after her initial diagnosis. Her trainer noticed a pimple on the back of her neck (see Our Story at www.side-out.org/about/our-story for more details).

PE: A side-out occurs in volleyball when a team wins a point while the opposing team is serving, thereby regaining the serve and control of the game. Why did you select volleyball as a fund-raising platform for breast cancer research?
Dunetz: As a practical matter, it was the only setting where Rick's vision could get donations. With my encouragement and support, we both saw an opportunity to reach out to high schools and colleges across the country. Our success was a complete surprise when we took our modest local program national and raised approximately $400,000 in the first year. With that success came

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Changing Tunes for Changing Times

Photo: © iStockphoto.com

Emergency response sirens, construction noise, airplanes, and road traffic play a constant soundtrack for many people living in the United States. We accept this noise pollution as a trade-off to living in urban and suburban homes. And we adjust. As humans we can choose how close we want to live to a noisy highway or the path we take to work through a construction zone.

But what about the wildlife living among us? How do animals respond to man-made noise? According to David Luther, an ornithologist and assistant professor of biology, "animals and insects that vocalize to each other — frogs, toads, insects, birds — adapt their calls to the urban environment where they live."

Photo: Courtesy of David Luther

David Luther

Last summer, Luther and fellow researcher Elizabeth Derryberry conducted a unique experiment in San Francisco where they tested the reactions of male white-crowned sparrows to birdsong recordings made in 1969 to recordings they made in 2005. Luther says, "historical comparisons are rare," and the recordings allowed him to assess how birds have changed their songs and if it in any way correlated to increases in noise pollution.

It was determined that the order of the notes was the same between the differing years but that 2005 songs were at a higher minimum frequency. The frequency change was measured against traffic flow increases throughout San Francisco and in the Presidio from the Golden Gate Bridge. An increase in traffic corresponded to the increase in frequency. Luther then played both the historical and current songs and found that the birds responded to all the songs, but "males responded to current songs more quickly and with more song, i.e. a stronger response to current songs."

"For some species we know that female birds are more attracted to songs with lower frequencies," says Luther. "But certain sounds transmit better in noisy environments, and in order to be heard, the birds are vocalizing at higher frequencies."

The experiment was conducted using an iPod loaded with the birdsongs placed in the middle of a known bird territory. "The males hearing the songs reacted as if an invader came into the area," explains Luther. "The birds would fly by, sing in response, peck at the speaker, and wave their wings."

Closer to home, Luther is working with some of his students to see if cardinals in the metropolitan Washington, D.C., area respond to similar frequency changes. This project is in conjunction with the Smithsonian Neighborhood Nestwatch program that works with backyard naturalists interested in tracking birds.

Luther says that some birds, like humans, speak a dialect depending on where they live and that in general birds can adapt their vocalizations to particular areas. The higher frequency songs seem to be better at eliciting a response from other birds, thus increasing the communication efficiency, but there is still much to learn about how this vocalization may affect mating or species communications and if there are any costs associated with singing the new songs.

Swan Research Combines Conservation Biology, Climate Change, and Genetics

The swan research program at Environmental Studies on the Piedmont, near Warrenton, Va., manages one of the largest research swan collections on the East Coast. Here, Patrick Gillevet and Thomas Wood have collaborated for ten years with William Sladen, founding director of the program and professor emeritus in the Bloomberg School of Public Health at Johns Hopkins University, in research on North America's native swans — the trumpeter and the tundra.

Gillevet, director of the Microbiome Analysis Center and a professor in the Department of Environmental Science and Policy (ESP), has brought his research focus on environmental molecular biology to swan genetics. Because the collection is home to the world's only known hybrids of the trumpeter and tundra swans, he and his team have been able to study all three variations. "We found that the hybrid offspring were fertile," Gillevet says, "which led us to work on the genetics to see if primers existed to distinguish the hybrid in the wild."

Wood, whose research focus is conservation biology, is a professor in Mason's New Century College and director of Environmental Studies on the Piedmont. There, he is investigating the behavioral and physiological evolution of the trumpeter and the tundra swans. "What we're trying to find is any genetic information that correlates to the divergence of the swan species, specifically their vocalization, behavior, and morphology," says Wood.

In summer, both species nest and breed in Alaska — the trumpeter swan in boreal forests and the tundra swan on the Arctic tundra. Both species traditionally migrated to the East and West Coasts for winter. However, the migratory trumpeter population on the East Coast was long ago hunted to extinction for skin and feathers; the population that migrates to the West coast survived.

Gillevet's population genetics study seeks to discover whether the two species are reproducing in the wild. He and his students are using next-generation genomic sequencing to search for markers in samples from swans in the Environmental Studies collection. Their results show that the two species are more closely related than previously hypothesized. "We think there are three possible causes, or a combination thereof, for the closer genetic relationship," explains Gillevet. The first possibility is a natural evolutionary process. The second is a population disruption caused by the near-extinction of the trumpeter swans and their subsequent reintroduction. The third is the two species' overlapping breeding ranges as the boreal forest expands into the tundra because of climate change.

Lauren Wilson, a doctoral student working with Gillevet, adds, "This research provides a great opportunity to investigate the relatedness of two living things, as well as possibly addressing how climate change has indirectly altered the evolutionary trajectory of species through vegetative disturbance. When habitat changes, the animal community responds, sometimes in fascinating but serious ways."

Wood is studying the calls of both species to compare their vocalization characteristics and has confirmed that the trachea of each species is different. The trumpeter has a longer, larger trachea than the tundra, and this difference is what produces the trumpeter's namesake call. "Because the swans breed in different locations, they may have developed different vocal patterns for communicating through the boreal forest versus out on the tundra," Wood notes.

The big picture — the evolution of the trumpeter and tundra swans — is where Gillevet's and Wood's research projects converge. Their studies explore population genetics, climate change, conservation biology, and interspecies differences, and how these factors affect the swans' evolution. Their findings on the effects of climate change, migratory pattern adaptation, and species reintroduction have significant implications for other Arctic species and help advance the dialogue on conservation biology.

Photos: Courtesy of Patrick Gillevet

Patrick Gillevet gets up close and personal in his swan research.

Summer Programs Explore Astrobiology and Real-World Applications for Math

Last summer, the College of Science hosted two summer programs for science learning. Several undergraduates and K–12 teachers worked with Mason math faculty members in an NSF-sponsored program that applied math to problem solving. An astrobiology program brought 10th-grade students from South Korea to investigate how certain sciences are connected through interdisciplinary research projects.

Photo: Creative Services

Padmanabhan Sheshaiyer (right) confers with Marissa Soucy (left), Simmons College (Boston, Mass.), about simulation-based research.

Undergraduates and Teachers Learn that Math is More than Numbers

Efforts to strengthen the future of mathematics are growing, and Padmanabhan Seshaiyer, professor of mathematical sciences, is on the cutting edge of the movement. He's committed to nurturing the next generation of mathematicians to ensure that they understand how "mathematics can be applied to qualitatively and quantitatively study science and engineering." Seshaiyer, along with other faculty members in the Department of Mathematical Sciences, leads Mason's own Research Experience for Undergraduates (REU). Funded by grants from the National Science Foundation, the program supports active research at universities chosen to serve as REU sites for two consecutive summers.

Photo: Courtesy of P. Seshaiyer

Students and Teachers from the 2012-2013 Research Experience for Undergraduates (REU) program

Mason has received this honor twice.

During the intensive nine-week program, the 2012–2013 cohort, a select group of eleven college students and two K–12 teachers, works with Mason faculty and graduate students to explore the role that mathematics plays in solving real-world problems.

Students explore the theme of the current program, mathematical and computational modeling of biological and bio-inspired engineering, through experimentation and simulation-based research. Given unlimited access to Mason libraries and computer labs, students employ mathematical and computational techniques to research a variety of topics, from predicting climate change, to understanding tsunamis, to studying disease dynamics models.

For many participants, the REU program is their first opportunity to collaborate with a professor for an extended period of time. Such experiences give participants a competitive edge when applying for graduate programs or jobs.

Another goal of the REU program is to prepare students to pursue multidisciplinary careers that bridge the scientific and engineering disciplines," says Seshaiyer. To that end, the REU program offers valuable career development and graduate school workshops. Program participants learn about math-related career fields firsthand through visiting organizations such as the National Institutes of Health and the National Institute of Standards and Technology.

Proof of the REU program's success is clear. "It has inspired me to push the limits," says a former participant, "to keep asking questions and keep believing we can solve any problem… I used to think doing research in math was purely proof-based. Now I see that research in math has endless possibilities."

Photo: Duane King

Tenth graders from Daegu Science High School in South Korea came to Mason to work with Michael Summers in a summer workshop on astrobiology.

South Korean Students Study Life in the Universe

When Michael Summers tells his students to reach for the stars, he's not kidding. Summers is the director of the School of Physics, Astronomy, and Computational Sciences, and he works with several NASA space missions. He also happens to be an international ambassador for astrobiology, the inter-disciplinary study of the origin and distribution of life in the universe.

It all started three years ago when a group of middle and high school teachers from South Korea asked Summers to give a talk about his work on NASA missions and astrobiology. Word spread. Since then, Summers has conducted a variety of lectures and workshops with Korean educators and middle and high school students. The most extensive of these offerings was a weeklong summer program for twenty-five gifted and talented 10th graders from Daegu Science High School in South Korea.

During their week at Mason, students worked in small groups on their assignment to design a space mission to search for evidence of life on other planets. Under Summers' tutelage, participants learned how to assess the habitability of a location and how to identify signatures of biology. Once students chose a destination for their mission, Summers used his professional experience to help students navigate mission guidelines similar to those used by NASA.

In his classroom, Summers finds that most students have little experience with truly interdisciplinary sciences such as astrobiology. "Most students can't see the forest for the trees," he says. While compartmentalized scientific disciplines have traditionally allowed scientists to tackle big problems in manageable doses,

> "The beauty of astrobiology is that it naturally integrates the disciplines of science in an effort to understand the largest story on the largest stage of existence: the story of life in the universe."

Summers argues that "we are now at the stage in science where those distinctions are damaging to the attempt to understand the big picture.

"More importantly," he adds, "failing to emphasize the interdisciplinary nature of sciences such as biology, chemistry, and physics is setting future scholars up to be poorly equipped to solve the myriad of complex scientific problems facing humanity." According to Summers, astrobiology provides students with the kind of interdisciplinary mental toolbox needed to address the biggest questions facing humanity. "The beauty of astrobiology," he says, "is that it naturally integrates the disciplines of science in an effort to understand the largest story on the largest stage of existence: the story of life in the universe."

NanoNotes

Elements of Distinction about the College of Science, its Faculty, Staff, and Students

Jagadish Shukla, Department of Atmospheric, Oceanic, and Earth Sciences, was honored with a Padma Shri award for distinguished service in the field of science and engineering. The award is bestowed annually by the government of India to recognize exceptional contributions in various spheres of activity.

Photo: Courtesy of Jagadish Shukla

Jagadish Shukla receives the Padma Shri award from India's President Pratibha Patil at Rashtrapati Bhawan, the president's home, on April 4, 2012.

Paul Cooper, Department of Chemistry and Biochemistry, received a 2012 Teaching Excellence Award from Mason's Center for Teaching Excellence. The award honors outstanding professors for their innovative teaching, advising, and mentoring.

Cynthia Warrick, PhD Environmental Science and Public Policy '99, has been named interim president of South Carolina State University in Orangeburg.

Patrick Gillevet, Department of Environmental Science and Policy, received a Tommy Award from the Thomas Jefferson Partnership Fund, a parent-driven nonprofit foundation that solicits support for Thomas Jefferson High School for Science and Technology (TJ). He was recognized for providing support and guidance to TJ students through the school's Mentorship Program for more than 15 years and for serving as a valuable resource for TJ teachers and lab directors.

Thomas Lovejoy, Department of Environmental Science and Policy, was a recipient of a 2012 Blue Planet Prize, awarded annually by the Asahi Glass Foundation in Japan to individuals or organizations that make outstanding achievements in scientific research and its application toward solving global environmental problems. He was recognized for his pioneering work in biodiversity science and conservation.

Dann Sklarew, Department of Environmental Science and Policy, was selected to participate in the Faculty Fellowship Summer Institute in Israel, which linked scholars from diverse disciplines with their Israeli counterparts at major institutions to initiate academic exchange, networking, and collaboration. Sklarew also was invited to teach a summer course, "The Role of the Corporation in Environmental Stewardship," at Sungkyunkwan University in Seoul, Korea.

Allison Macfarlane, Department of Environmental Science and Policy, was nominated by President Barack Obama and confirmed by the U.S. Senate as chair of the Nuclear Regulatory Commission. Her appointment began July 9.

Photo: Creative Services

Allison Macfarlane

Robert Slate, a doctoral student in the Environmental Science and Public Policy program in the Department of Environmental Science and Policy, was selected to participate in the National Science Foundation-funded EcoHealthNet 2012 Workshop on disease outbreak, modeling, and investigation at the University of Wisconsin and the U.S. Geological Survey National Wildlife Health Center in Madison, Wis. He also participated in the EcoHealth Alliance 2012 Research Exchange in New York City, where he presented his project, "Enabling Web-Based Animal Disease Surveillance."

Padmanabhan Seshaiyer, Department of Mathematical Sciences, recently completed an assignment at the Nelson Mandela African Institute of Science and Technology in Tanzania as part of a National Academy of Science visiting professorship program. His work included the creation of teaching, research, and STEM outreach curricula and infrastructure, work with faculty and students to enhance their research portfolios, and initiation of new research collaborations between the United States and Africa.

Robert Sachs, Department of Mathematical Sciences, was selected for the 2012 David J. King Teaching Award by Mason's Center for Teaching Excellence. The award is presented to a professor who has made significant, long-term contributions to the overall educational excellence of the university.

Karl Haislmaier, an undergraduate student in the School of Physics, Astronomy, and Computational Sciences, won a $25,000 second prize in the New Cosmic Frontiers International Science Essay Competition on the Nature of Our Universe and its Habitats, led by the University of Chicago and funded by the John Templeton Foundation. His winning entry was "The Emergence of Complexity in the Universe as Viewed from a Holistic Perspective."

Daniel Cox, School of Systems Biology, was one of three national recipients of the Outstanding Mentor Award presented by the Council on Undergraduate Research Biology Division. This annual award recognizes exemplary mentorship of undergraduate research in the biological sciences. He also was one of five recipients of the inaugural OSCAR Mentor Award, presented by Mason's Office of Student Scholarship, Creative Activities, and Research. The award recognizes faculty members who mentor undergraduate students on research and creative activities and foster a culture of student scholarship.

Nazly Shafagati, a doctoral student in the Biosciences program in the School of Systems Biology, received a $55,000 fellowship from the National Center for Foreign Animal and Zoonotic Disease Defense. She plans to use the award to support her dissertation work.

Massih Abawi, a doctoral student in the Biosciences program in the School of Systems Biology, presented a lecture on the correlation between Vitamin D levels and markers of apoptosis in patients with nonalcoholic fatty liver disease at the Digestive Disease Week annual conference in San Diego, Calif.

Faculty, staff, students, and alumni are encouraged to send their NanoNotes *to cosnews@gmu.edu.*

Collaborative Effort Prepares Future STEM Teachers

The College of Science (COS) will receive $1.5 million over the next five years from the National Science Foundation's Robert Noyce Teacher Scholarship Program to prepare future secondary teachers in science, technology, engineering, and math (STEM) disciplines. Mary Nelson, assistant professor in the college's STEM Accelerator and the Department of Mathematical Sciences, is the principal investigator on this interdisciplinary endeavor, which also includes Cody Edwards and Reid Schwebach in COS, and Len Annetta in Mason's College of Education and Human Development (CEHD) as co-principal investigators, along with collaborator Calvin Bentley at the Annandale Campus of Northern Virginia Community College (NVCC).

"This is a great opportunity for the College of Science to contribute to President Barack Obama's call for 100,000 new STEM teachers over the next decade," says Nelson, who implemented a Noyce scholarship program at the University of Colorado-Boulder before coming to Mason. "Fifteen students graduated as licensed teachers under that program," she adds.

Funds will be used to support learning assistants in the STEM Accelerator and STEM classrooms at NVCC/Annandale. Talented students at Mason and NVCC who are interested in teacher licensure in STEM disciplines may apply for the positions. Learning assistants will gain practical teaching experience and develop confidence in their skills and abilities by working with other students. They will share a strong mentoring relationship with their own instructors and have opportunities to develop their professional skills by presenting talks and posters at conferences, leading recitation sections, and through other classroom experiences.

Noyce Scholars also will be funded by the program. Successful Mason candidates will receive $10,000 per year in tuition support for up to three years in return for their commitment to teach for two years in a high-needs school district for every year as a Noyce Scholar.

"The hallmark of this program is the interdisciplinary, collaborative effort being undertaken by COS, CEHD, and NVCC," says Tim Born, COS associate dean for academic and student affairs. "Each partner has a key role that will contribute to the success of our students as they prepare for teacher licensure, and working with community college students will allow us to create support programs that will help ease their transition from NVCC to Mason."

Supercharged Computer Models for Climate Change Research

When talking about the politics and effects of global climate change, Jim Kinter views the issue from its human development effects as well as the global application to climate studies. Kinter, a professor in the Department of Atmospheric, Oceanic, and Earth Sciences and director of the nonprofit Center for Ocean-Land-Atmosphere Studies (COLA), says the scientific community no longer debates the validity of climate change. However, he recognizes that the issue is still highly charged and polarizing.

"As scientists, we are curious how the Earth's climate system works and is responding to this big punch in the face." To direct the global conversation, he and his colleagues must collect the data that have error bars and are both rigorous and quantified. Most climate change analysis is done through computer models, and Kinter says, "By pushing the models we're using, we get answers consistent with older models but with much greater detail and accuracy and some surprises." This quality of data helps scientists understand climate change and better communicate the problems.

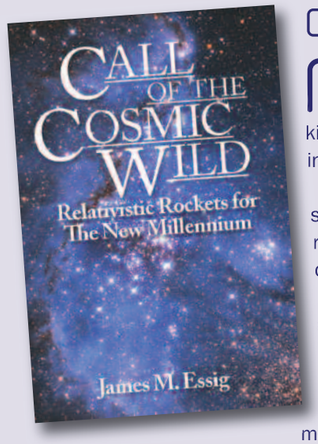
In 2010, Kinter was part of a team of thirty researchers in six groups from the United States (including COLA and Mason), Japan, and the United Kingdom who were working on the Athena Project. The task was to see if enhanced spatial resolution could improve climate model fidelity. The six-month project funded by the National Science Foundation gave researchers access to the Athena computer located at the Oak Ridge National Laboratory in Oak Ridge, Tenn. Athena is one of the largest distributed computing environments in the world. The team ran client simulations with grid resolutions ranging from 125 kilometers to seven kilometers.

Kinter says that "this is a unique data set." Researchers now have moved from planetary scale models to place-specific, country-by-country and even state-by-state models. The data mean that scientists can more accurately predict drought regions and areas subject to torrential flooding. The challenge now is to study the 1.2 petabytes of data that Athena generated.

Since the computing phase, six papers have been published, with three more in review, covering various aspects of current and future climate, including land-atmosphere feedback, extreme drought, regions of atmospheric storminess, and tropical cyclones. "The analysis has taken longer than the computational phase because the volume of data is immense," says Kinter.

The next phase of research is Project Minerva, which will give researchers even greater computing power and the ability to look at the El Niño effect and monsoons that affect South Asia, as well as variations caused by sea ice.

Kinter is excited by this research and sees Mason as a place where specialized climate studies can have a home. Currently, Mason offers students a strong foundation in climate dynamics, communication, biodiversity, ethics, and other aspects of climate change. He says that the university would like to connect these fields and create an interdisciplinary course of study. "Mason is a great place for this to happen," says Kinter. "We are located near the federal government, so we could become the go-to climate variability and change center."



COS Alum Heeds the Call of the Cosmic Wild

More than a decade ago, James M. Essig, BS Physics '01, traveled across the stage in Mason's Patriot Center to receive his diploma. Even then, he had ideas about a different kind of travel. Essig recently published his first book about the role of relativistic rockets in interstellar space travel, and his second book on the topic is due out later this year.

Essig says that *Call of the Cosmic Wild: Relativistic Rockets for The New Millennium* offers simple mathematical and visual explanations about interstellar travel. In addition to relativistic rockets, he discusses other methods of interstellar travel such as astrodynamic shielding and drag reduction at velocities near the speed of light.

"Numerous tables, graphs, electronic drawings, and photographs help explain my whimsical ancillary arguments for why extremely high gamma factor inertial space travel may have merits over other speculative concepts, such as wormhole travel, faster-than-light inertial travel, warp drive, and the like," he says.

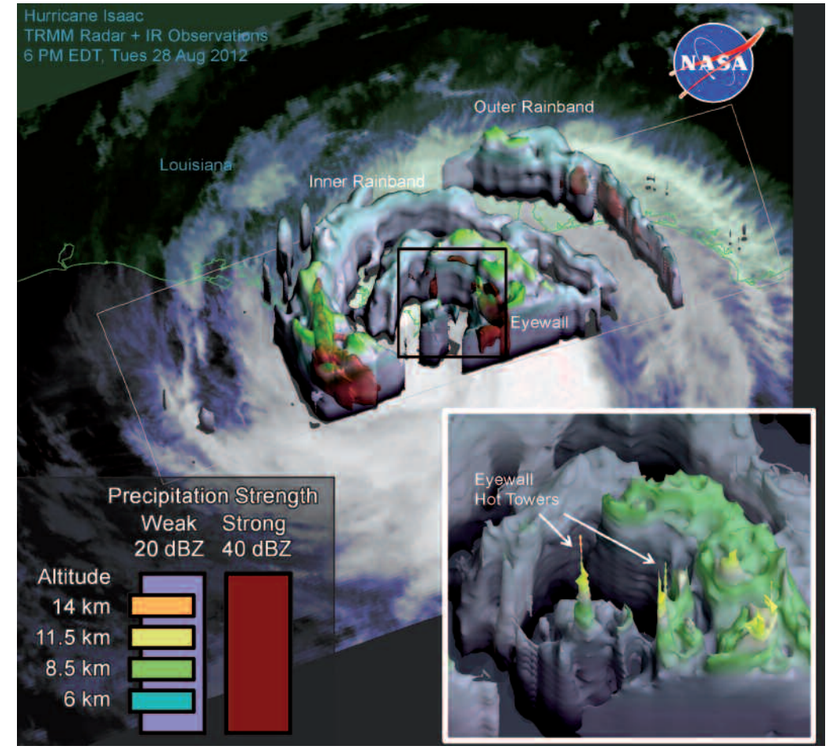
Essig intends his book to foster dialogue on potential real-world methods of interstellar manned space exploration. "It is a serious scientific and moderately technical document on relativistic rocket concepts as commonly contemplated in the relativistic astronautics research community. However," he adds, "many concepts previously developed by others are recast in more extreme but plausible scenarios with good argumentative grounding."

COS Researchers Work to Measure Rain from Space

Inside the renowned NASA Goddard Space Flight Center in Greenbelt, Md., sits a bit of the College of Science. It's neither a traditional classroom nor a campus lab but a substantial part of a research center nonetheless, the Center for Earth Observing and Space Research — or CEOSR, pronounced Caesar, as in *hail to*. And hail may be an apt pun as hail is a form of precipitation, and John Kwiatkowski, a research professor in the Department of Geography and Geoinformation Science (GGS), is working on microwave remote sensing for measuring precipitation. NASA wants to measure global precipitation from space.

"Peggy Agouris, GGS department chair and CEOSR director, brings the science, research and real-world data that comes from the center to the classroom," explains Kwiatkowski. "Mason's location near NASA Goddard is ideal for students who are interested in working on real-world data models and their applications to global climate studies." For his part, Kwiatkowski teaches as well, and this semester, he will be lecturing in several 500-level classes.

This current CEOSR contract to Agouris and Kwiatkowski for $11,575,025 will run for the next four and a half years and is funded by the Arctic Slope Regional Corporation. It's also a joint U.S.-Japanese project, the Global Precipitation Measurement (GPM) mission. Researchers in Japan have built the radar equipment, and it is now being integrated into the spacecraft here in the United States. When complete, the spacecraft will be sent back to Japan and launched.



TRMM data courtesy of NASA and JAXA. Image generated at NASA Goddard's Precipitation Processing System (PPS) by Owen Kelley (NASA,GMU/CEOSR).

TRMM satellite overflight of Hurricane Isaac, 6 PM on August 28, 2012

The TRMM radar saw two hot towers (a sign that energy is being pumped into the hurricane from the ocean's surface) in the eyewall of Hurricane Isaac just hours before landfall. Infrared observations give a sense of the height of the cloud cover hiding the heavy precipitation inside. Insert reveals details at the center of the hurricane.

"Six months after launch, we will start to distribute data," says Kwiatkowski.

The first satellite with this type of microwave sensing was launched in 1997—also a joint U.S.-Japanese project, the Tropical Rainfall Measurement Mission (TRMM). The TRMM satellite was able to provide data for only the tropics. Kwiatkowski explains, "The length of the mission is limited by the amount of fuel that the craft has in orbit. In 2001, the orbit was raised to conserve fuel and to extend the life of the TRMM mission. It's possible that this equipment may continue running until 2014. If so, we will have two space-born radars capable of giving us a more complete view of the Earth. The TRMM satellite will help us calibrate the new equipment."

The TRMM satellite and this newer satellite also use a microwave radiometer, a passive device that measures and records the Earth's natural microwave emissions. The equipment has the ability to measure the amount of water in its field of vision. "With detailed measurements of rainfall in precise locations, hydrologists can model how much water runs into streams and over farmlands," explains Kwiatkowski. Improved climate models help every nation manage climate change.

Greenhouse Provides a Colorful Learning Oasis

Photo: Creative Services

Student volunteers at the greenhouse sow seeds of different types of vegetables.

The greenhouse on the Fairfax Campus is a light-filled green space for research. As part of the Department of Environmental Science and Policy (ESP), it supports coursework and research projects by housing a rotating set of experiments for ecology and microbiology classes. Showcasing a permanent collection with representatives from the major plant families, the greenhouse is a brilliant display of specimens. Its diverse plant collection—ranging from aquatic plants to cacti—demonstrates specimens of different plant families and their varying characteristics.

ESP greenhouse manager Monica Marcelli maintains the greenhouse and prepares lab experiments for environmental science and microbiology courses. "The plant biology lab needs a variety of plant specimens to display for teaching," says Marcelli. Students in these labs observe ferns, bryophytes (mosses, liverworts, and hornworts), angiosperms (flowering plants), and gymnosperms (plants that produce naked seeds).

Ecology lab students are using radishes to evaluate how intraspecific (same species) competition for nutrients, water, and light affects plant weight. "The students start the radish seeds in the lab," Marcelli explains, "and then we grow the plants in the greenhouse until harvest." A microbial ecology lab experiment compares the root nodule development, biomass weight, and dry weight in soybeans grown with and without rhizobium inoculum in different soil types.

Besides supporting plant experiments, the ESP greenhouse provides plants for entomology research both at Mason and at neighboring institutions. "We're growing pawpaw trees, a native species, from seed," Marcelli says. "They will support research evaluating the feeding habits of the zebra swallowtail butterfly."

The greenhouse collaborates with the Smithsonian Institution's National Museum of Natural History (NMNH) and other institutions on entomology and biology projects. The ecology lab grew tomato, tobacco, and radish plants to study the eating patterns of tobacco hornworm larvae. "We donated the extra tomato plants to the insect zoo [in the NMNH] to feed its tobacco hornworms," notes Marcelli, "and the extra tobacco plants to the George Washington University greenhouse."

The greenhouse supports the Mason Organic Vegetable Garden by harboring seedlings until they are strong enough to be transplanted to the field. Student volunteers cultivate the garden, and half the produce goes to homeless shelters. "Students from the garden also volunteer at the greenhouse," adds Marcelli, "and this help is very valuable."

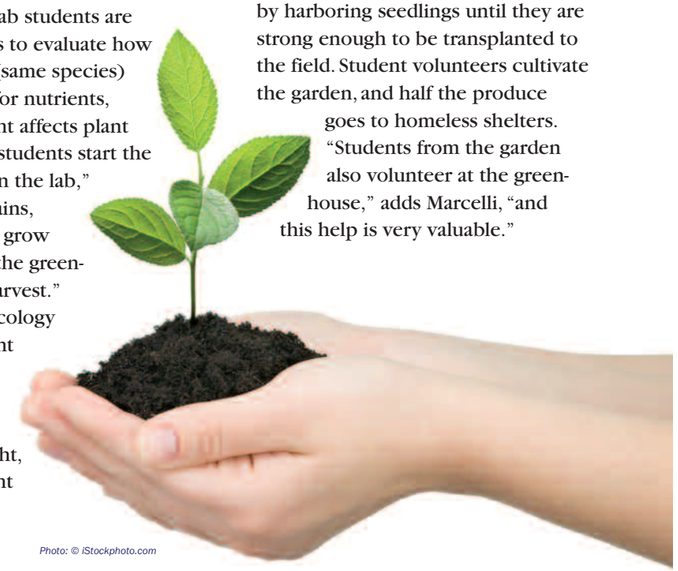


Photo: © iStockphoto.com

***Side-Out**, from page 2*

the responsibility for me to put this money to work on the most advanced research in breast cancer.

PE: Why did The Side-Out Foundation choose to work with the Center for Applied Proteomics and Molecular Medicine?

Dunetz: I was introduced to the world of clinical trials by Gloria's oncologist when seeking advice on how to invest the money we received from donations. It was through Dr. Nicholas Robert of Virginia Cancer Specialists in Northern Virginia that I was introduced to Dr. Daniel Von Hoff of the Translational Genomics Research Institute in Phoenix, Ariz., who had just completed one of the most successful trials there and at Scottsdale Healthcare.

Dr. Von Hoff recommended that Side-Out should organize its own trial. I was then introduced to molecular profiling testing at the Molecular Profiling Institute in Phoenix, Ariz. However, I was not satisfied to use only one source to determine a treatment regimen, which led me to proteomics and protein signal pathway testing at CAPMM.

PE: What accomplishments would you like to see in Side-Out's future?

Dunetz: The lion's share of our donations is devoted to clinical trials that use the most advanced science and biology to treat patients in real time and eventually will cover the full life cycle of the disease. We are moving to a "three-legged stool" for diagnostics in the next trial, which takes advantage of the most recent gains in real-time and affordable molecular analysis (such as genomic sequencing), combined with CAPMM's reverse phase protein microarray analysis and immunohistochemistry to identify targets for treatment with the latest FDA-approved drugs.

www.side-out.org

Dean's Message

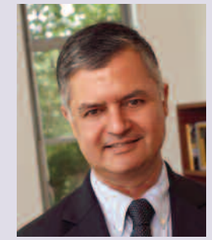


Photo: Creative Services

Vikas Chandhoke
Dean, College of Science

If you've been a regular reader of *Periodic Elements*, you'll notice that it has expanded to a full magazine format with this issue. This growth is an exciting change for us as it mirrors the growth happening in the College of Science. The expanded format allows for more in-depth coverage and imagery of the research, learning, and accomplishments happening daily in our labs and classrooms.

Our first magazine explores the multidisciplinary nature of our curricula, most notably, how changes in global climate and human urbanization are affecting plants and animals. A hallmark of the college is global outreach and how our international efforts to share data and collaborate with research facilities locally and across the globe help power the world's scientific community.

Scientific research and teaching are year-round activities that happen at multiple locations. We are pleased to highlight some of the interesting summer events and important research that is accomplished at other locales, such as swan studies in Warrenton, Va., and ongoing microwave remote sensing for measuring precipitation at the NASA Goddard Space Flight Center in Greenbelt, Md.

We also celebrate our students, faculty, and alumni for their contributions and successes. With hopes of increased funding for research, new classroom space in the works, and new programs in the planning stages, there is more to talk about than at any time in the short history of the college.

COS Fall Lineup*

Total Students:	3,385
Full-time:	2,276
Part-time:	1,109
Female:	1,865
Male:	1,516
Gender Not Reported:	4
Undergraduate:	2,265
Graduate:	1,120

**As of August 2012*

Periodic Elements

Read past issues of Periodic Elements at cos.gmu.edu

Where Science and Art Intersect

Each summer, students in the Aspiring Scientists Summer Internship Program (ASSIP) explore real-world problems through unique, hands-on scientific research. They also are challenged to merge science with a healthy dose of creative thinking to produce an art project that reflects their laboratory experience. These projects are later displayed at the Science Museum of Virginia in Richmond.

"Because they know they have to represent their research through art, the students ask more questions as they plan experiments, collect data, and analyze results," explains ASSIP director Amy VanMeter Adams. She says the students learn the importance of creativity and innovation, which are critical in order to make advancements in science. "Thinking outside the box is a key aspect involved in becoming a successful scientist."

A Different Perspective

by Alexandra Zeller

Through her ASSIP research, Alexandra Zeller, a Mason junior studying applied mathematics, worked with mentor Padmanabhan Seshaiyer, a professor in the Department of Mathematical Sciences, to develop and analyze mathematical models to predict stages of the symbiotic relationship between rhizobium bacteria and legumes. Finding the ideal conditions for a peaceful existence between the two would greatly reduce annual expenditures on fertilizers required to increase crop production, resulting in a positive impact on the global economy and larger food supplies for societies around the world.

"For my scientific project, I worked with legumes and decided to use them as a medium for my art project," Zeller says. "The entire picture is composed of various members of the legume family, specifically beans. The binary code represents the many codes I wrote and how vital they were to my research. Finally, the clover represents another member of the legume family, as well as sheer luck!"