MEET NC STATE SCIENTISTS

In 2013, the U.S. Census Bureau reported that women, African-Americans and Hispanics are significantly underrepresented in STEM fields. Part of the problem appears to be that women and people of color don’t see themselves in many STEM fields. One step forward in addressing this imbalance is to highlight diverse role models in STEM.

In April 2014, the university launched “This Is What Science Looks Like at NC State,” an online series that highlights the diversity of researchers in science, technology, engineering and mathematics. Rather than featuring glossy profiles, the series allows researchers to write about their own experiences and what drew them to their respective fields.

Since launching, the series has profiled more than three dozen researchers — from undergraduates to well-established faculty — all of whom are members of underrepresented groups in STEM fields. It’s received an enthusiastic response, and other universities have contacted NC State about starting similar projects. To learn more about the series, visit http://news.ncsu.edu/tag/what-science-looks-like/.

CONSORTIUM FOCUSES ON NUCLEAR NONPROLIFERATION

NC State has been awarded a five-year, $25 million federal grant to develop the next generation of leaders with practical experience in technical fields relevant to preventing the spread of nuclear weapons around the globe.

The National Nuclear Security Administration’s Office of Defense Nuclear Nonproliferation Research and Development noted that NC State was selected over 22 other proposals.

The university’s new Consortium for Nonproliferation Enabling Capabilities, or CNEC, will serve as a research and education hub for the development of enabling technologies and technical talent in the field over the coming decade.

“For NC State to be selected to lead this vital national effort is a testament to our great faculty and strong leadership in nuclear engineering,” says Chancellor Randy Woodson.

CNEC will implement educational activities aimed at developing a pool of future nuclear nonproliferation and nuclear security professionals and researchers. In addition, the consortium will provide the U.S. government with cutting-edge research and development to identify and address multidisciplinary and cross-functional technology and research needs that are critical to detecting foreign nuclear weapon proliferation activities.

“This grant will link students with world-class researchers and introduce them to career possibilities at the national labs while providing education in areas of great importance for the nonproliferation mission,” says Anne Harrington, NNSA deputy administrator for defense nuclear nonproliferation.

Robin Gardner, professor of nuclear and chemical engineering and director of the Center for Engineering Applications of Radioisotopes, will lead the consortium. John Mattingly, associate professor of nuclear engineering, is co-principal investigator on the project.

CANCER COP TARGETS UV DAMAGE IN DNA

We know that prolonged sun exposure damages skin — the sun is a nuclear reactor, after all. But how does our body respond to and repair this damage at the DNA level?

NC State experimental biophysicist Hong Wang is part of a team led by Bennet Van Houten of the University of Pittsburgh School of Medicine that studied a DNA repair protein called UV-DDB (which stands for UV-damaged DNA-binding protein) and how it does its job.

UV-DDB is constantly scanning strands of DNA looking for sites of damage. UV-DDB is the first protein at the scene of UV-induced DNA lesions. If these lesions aren’t located and fixed, they could impair a cell’s ability to divide properly, leading to mutations and, over the long term, to cancer.

When UV-DDB spots a lesion, it calls for backup. A team of 20 different “first responder” proteins show up and remove the DNA lesions, allowing the cell to divide normally.

The researchers wanted to know how,
UV-DDB prefers a three-dimensional search, or jumping, to a one-dimensional search, or sliding, when it “interrogates” the DNA for damage. That’s because the 3-D search makes it easier for UV-DDB to navigate obstacles like histones and other proteins when it’s searching for lesions.

To learn how UV-DDB moves, the researchers tagged it with fluorescent nanoparticles that allow researchers to track individual UV-DDB proteins. Using a high-speed camera (20 frames per second) and a fluorescence microscope, researchers captured video of UV-DDB’s movements on DNA. They learned that UV-DDB walks its beat. In each cell, there are about 180,000 of these protein “cops,” but there are several billion DNA base pairs in the human genome, so the cops have a lot of ground to cover on every strand of DNA.

Proteins can move along strands of DNA in different ways: They can slide along the strand like skateboarders grinding a rail (called a one-dimensional search), or they can jump on and off of the strand at different points — a three-dimensional search.

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DO PEOPLE AND PIGS SHARE SALMONELLA STRAINS?

If antimicrobial-resistant Salmonella is showing up in pigs, then are bacon-loving people also at risk? In his latest research, NC State population health and pathobiology professor Sid Thakur looked at serotypes, or groups, of antibiotic-resistant Salmonella in people and pigs to try to determine whether these strains are being passed from pork to people.

Thakur took samples from 30 North Carolina farms — from the pigs and their surrounding environments, including everything from feed to floors — and found seven predominant serotypes of antimicrobial-resistant Salmonella. One of them, Salmonella Typhimurium, was also found in human clinical samples Thakur collected.

“Depending on the serotype we’re looking at, we can find similar serotypes in pigs, people and the environment,” Thakur says. “However, the individual genetic ‘fingerprints’ of serotypes can differ. In this case, only Salmonella Typhimurium was the same for people and pigs; however, that doesn’t mean that we can say people are getting this illness from pigs or vice versa.”

Thakur also notes that while the serotypes were the same, the resistance profile — in other words, the sound and felt the buzz on the side of the neck, and turned away,” Ray recalls with a smile.

The results lasted longer than the students had hoped. “Almost two months later, the elephant still didn’t want to go back to the area,” Besaw says.

The collar, created in collaboration with electrical and computer engineering students Layne Whaley, Peter Panburana, Courtney Comford, Emma Besaw and Justin Keaton, transmits sounds and vibrations that mimic bees and ants, which elephants avoid. Powered by solar-panel-charged batteries, the waterproof collar has GPS tracking capability and uses a strategy similar to an invisible pet fence.

With support from the U.S. Army Research Office and a partner agency, Adventures with Elephants, the NC State team headed to South Africa over spring break to try out two prototypes on the animals — a real think-and-do challenge.

Obstacles included detours caused by flooding. The powerful, water-loving elephants gave the collar and its electronics a serious workout, too, forcing students to improvise on the spot. “You can’t just run down to Lowe’s for replacement parts,” Barnes says.

Hampered by limited Internet connections in the field, enterprising team members had to figure out ways to make the device function. All of the students’ work led up to the moment when results played out in real time.

As an elephant approached a GPS-mapped boundary, team members activated the collar and held their collective breath. “The elephant heard the sound and felt the buzz on the side of the neck, and turned away,” Ray recalls with a smile.

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Thakur also notes that while the serotypes were the same, the resistance profile — in other words,
the drug that the serotype is resistant to — differs from human to pig populations. "In pig populations and their environment, all of the samples we looked at were primarily resistant to tetracycline, which is an antimicrobial commonly used in production environments," he says. “In humans, the resistance profile was much different.”

So what does this mean for consumers? As always, proper cooking and food handling practices eliminate 99 percent of the problem. “Further studies to determine the role played by different reservoirs — people, pigs and environment — in the food chain will be key to determining which direction the infection is flowing from,” Thakur says.

Thakur’s results appear in Foodborne Pathogens and Disease.

IMPROVING AFRICAN SWEET POTATOES

NC State will receive $12.4 million over the next four years from the Bill and Melinda Gates Foundation to improve a crop that is an important food staple in sub-Saharan Africa — the sweet potato.

The grant will fund work to develop modern genomic, genetic and bioinformatics tools to improve the crop’s ability to resist diseases and insects and tolerate drought and heat.

Craig Yencho, an NC State horticultural expert who heads the university’s sweet potato breeding program in the College of Agriculture and Life Sciences, is the project director. He says that sweet potatoes have a number of valuable characteristics that make them an attractive African crop.

“Sweet potato is a hardy crop that can be planted in drought-prone and low-fertility soils,” Yencho says. “Orange-fleshed sweet potatoes, which are an excellent source of vitamin A, rank first in nutritional quality among root and tuber crops grown in sub-Saharan Africa, providing vitamins for millions of people.”

Chancellor Randy Woodson praised Yencho’s work on sweet potatoes in Africa and in North Carolina, which leads the United States in sweet potato production.

“Dr. Yencho’s work on this important crop has led to a number of new varieties and improvements in sweet potatoes grown across the world, and is an excellent example of NC State’s think-and-do mentality,” Woodson says. “The international collaboration he’ll head will use interdisciplinary teams to gain critical knowledge — and share that knowledge — to help feed a continent.”

NC STATE LEADS POWERAMERICA

NC State’s leadership of the $140 million Next Generation Power Electronics National Manufacturing Innovation Institute, or PowerAmerica, continues to move forward with four other universities, 12 industry partners and two government labs in the consortium.

Announced by President Obama earlier this year, the institute will develop advanced manufacturing processes that will enable large-scale production of wide bandgap (WBG) semiconductor-based power electronics, which allow electronic systems to be smaller, faster and more efficient than power electronics made from silicon.

“NC State couldn’t be more proud to have been selected to lead this institute, which truly embodies everything that our university stands for — from our think-and-do philosophy to our collaborative spirit and commitment to solve the grand challenges of society,” says Chancellor Randy Woodson.

A recognized leader in developing WBG technology, NC State will unite the industry, academic and government partners in their effort to revolutionize energy efficiency across a wide range of applications, including electronic devices, power grids and electric vehicles. In addition to developing manufacturing processes, the consortium will develop devices and packaging materials that take advantage of the technology’s higher temperatures and voltages.

But the payoff could be huge. WBG power electronics technology has the potential to reshape the global market for power electronic components by increasing the efficiency of everything that uses power electronics, from industrial motors and consumer electronics to data centers and renewable energy systems. The WBG share of the international lighting market alone is expected to reach $84 billion by 2020.

WBG technology also eliminates up to 90 percent of the power losses that occur when converting from alternating current to direct current and vice versa. It can handle voltages more than 10 times higher than silicon-based devices, greatly enhancing performance in high-power applications. And it can operate at more than twice the temperature of silicon-based devices, resulting in better reliability and efficiency.

“The innovations developed by PowerAmerica will give U.S. manufacturers a head start and competitive edge in the emerging WBG market. This is a game changer,” says Terri Lomax, vice chancellor for research, innovation and economic development.

Learn more at ncsu.edu/power.

HARNESSING CROWDS TO ANALYZE CLOUDS

When it comes to analyzing hurricanes and other tropical cyclones, lack of data isn’t the problem. Scientists have 30 years of satellite images of these massive storms. What they don’t have is reliable data about cyclone intensity, because analysis methods have changed through time and from one region to another.
One of the best methods for determining cyclonic intensity remains human observation and classification of images. But the volume of data is daunting, especially when each image needs to be analyzed by several different people for consistency. Researchers from NC State’s Cooperative Institute for Climate and Satellites — North Carolina (CICS-NC) have come up with an innovative solution to the problem: Recruit and train citizen scientists to analyze the images online.

CycloneCenter.org launched in 2012, with a backlog of 200,000 satellite images of cyclones that needed analysis. A collaboration among CICS-NC, the University of North Carolina at Asheville, the National Oceanic and Atmospheric Administration and the Citizen Science Alliance, the website recruited volunteers and taught them to classify images.

In a paper in the Bulletin of the American Meteorological Society, the Cyclone Center gave preliminary results. “We’ve had about 350,000 classifications in two years,” says Carl Schreck, CICS-NC research associate. “We want each of our 200,000 images to be classified by 10 different volunteers, in order to reduce uncertainty or error.”

So far, the results are encouraging. “Beyond classifying and cataloging these storms, we’ve also demonstrated that you can get people with nonscientific backgrounds involved in scientific research, with positive results,” Schreck says.

Interested in volunteering? Go to CycloneCenter.org.

**SURVEY OF TRIANGLE ENTREPRENEURS SHOWS OPTIMISM**

NC State has launched a new quarterly survey to measure the outlook of Triangle entrepreneurs — and the initial results show significant optimism for increased revenue, spending and employment well into spring 2015.

“The goal of the Quarterly Outlook of Triangle Entrepreneurs (QuOTE) survey is to help entrepreneurial companies and state and local government officials in the Triangle anticipate business decisions and plan for growth,” says Jeff Pollack of the Poole College of Management at NC State, who developed the survey.

Conducted by the NC State Entrepreneurship Clinic, QuOTE is adapted from a similar national survey of large national companies that is conducted by the Business Roundtable, an association of CEOs of American companies.

In the initial results, 86.9 percent of the 199 Triangle-area entrepreneurs who were surveyed expected an increase in revenue over the next six months, while only 4 percent anticipated revenue declines. Meanwhile, 60.3 percent of respondents expected to hire new employees over the next six months, as opposed to 2.5 percent who anticipated decreases in staff. And 55.8 percent predicted an increase in domestic capital spending, with 5.5 percent anticipating spending cuts.

“The optimism found in the survey confirms what we hear from entrepreneurs on the street,” says Lewis Sheats, senior lecturer of entrepreneurship in Poole College and the director of the NC State Entrepreneurship Clinic.

A full report on the findings is available online at http://tec.poole.ncsu.edu/engaging/quote-results/. Anyone who wishes to participate in the survey or who would like to receive email updates about future quarterly surveys should contact the organizers at TheEClinic@ncsu.edu. Participation is free. Responses are confidential.

**STUDY OFFERS INSIGHT INTO CHALLENGES FOR COLLEGE ATHLETES**

A new study from NC State sheds light on how some collegiate student-athletes deal with uncertainties ranging from excelling in both school and sports to their career prospects outside of athletics.

“We wanted to explore how student-athletes at top-tier universities cope with the dual challenges of meeting the expectations of their teams while simultaneously complying with their responsibilities as university students,” says Lynsey Romo, a communication faculty member at NC State and lead author of a paper on the work.

The study was based on in-depth interviews with 17 student-athletes at a university that is considered to be elite in both its academic and athletic programs.

The researchers found that student-athletes reported feeling uncertain in three areas: personal uncertainty, such as uncertainty about injury or about balancing school work and sports; social uncertainty, such as uncertainty related to who their “real” friends are; and future uncertainty, such as uncertainty concerning their post-collegiate careers and whether the time they spend pursuing athletics will hurt their career prospects.

Most of the student-athletes reported using a variety of techniques to reduce uncertainty. These uncertainty-reduction strategies included seeking social support from friends, family or academic counselors; socializing with friends to take a break from sports and school pressures; negotiating with coaches in an attempt to increase their scholarship; and sometimes concealing their athlete status from peers to minimize people befriending them for the wrong reasons or to prevent negative stereotypes. Other student-athletes came to terms with uncertainty as a natural part of life and turned to prayer to help them cope.

The paper, “‘You Never Know What’s Gonna Happen’: An Examination of Communication Strategies Used by College Student-Athletes to Manage Uncertainty,” is published online in the journal Communication & Sport. The paper was co-authored by NC State undergraduates Christine Davis and Alyssa Fea.