Game changers: that’s one way to describe the scholars you will read about in the following pages, and the impacts they have had on USC in their short time here.

This spring, we are proud to honor 15 outstanding junior faculty as Breakthrough Stars, in recognition of their achievements as top-notch researchers and educators. These individuals represent the very best in scholarship at the University of South Carolina in an array of disciplines from the sciences to media arts. They arrived at Carolina aiming to meet high expectations — and promptly exceeded those expectations, achieving a level of excellence beyond what was asked of them.

The Office of Research is also pleased to recognize 14 Breakthrough Graduate Scholars. Nominated by their graduate program directors, these outstanding students are already making considerable contributions to research and scholarly activities in their fields, and are poised to be among the university’s strongest ambassadors for years to come.

PRAKASH NAGARKATTI, PH.D.
VICE PRESIDENT FOR RESEARCH
Darlene Amendolair hopes her research on simulation-enhanced learning can have an impact on the faculty and nursing shortage in the U.S. and beyond.

Using a web-based program, Amendolair has created a virtual environment for students to become immersed to practice psychomotor, affective and cognitive nursing skills on simulated patients.

“Nursing education is heavily reliant on real-life interaction with patients,” Amendolair says. “Unfortunately, clinical sites are getting harder and harder to find. We need to find or create other ways for students to get that experience.”

Unlike simulation with mannequins, web simulation allows students to interact with patients in a non-static way that more closely resembles actual patient care situations. Amendolair says students do better on tests and demonstrate more attention to patient details after engaging in simulated learning activities.

“It’s creating an environment in which students can learn and practice,” she says. “The amount of information that nurses have to know is tremendous and there’s not enough time in four semesters to do that unless we can create additional environments in which students can practice.”
You can learn a lot from a xenolith — especially one that has risen from the otherwise inaccessible depths of the earth.

Formed when a hunk of rock becomes embedded in a larger rock of a different type, such fragments often work their way to the Earth's surface via lava flows. Those specimens provide geochemists like Michael Bizimis with clues to the makeup of the planet’s mantle and a way to study the processes by which Earth has evolved over time.

“That’s the big picture, but ultimately I care about how elements such as magnesium, iron, calcium and the rare earth elements move from one reservoir to another,” Bizimis says. “That could mean how certain elements make it to the lava from the mantle, while others stay behind, or it could mean how certain metals move from sediments to the water in a marsh on the coast.”

And these are not just academic questions, as he explains: “There are fundamental applications for this science, from helping us know where to find oil deposits, to understanding how much water there is on the planet.”
HEXIN CHEN

ASSISTANT PROFESSOR, BIOLOGICAL SCIENCES
College of Arts and Sciences

Like everyone striving to bring an end to cancer, Hexin Chen knows the difficult history of the long war against the disease.

“Over the past 50 years, the survival rate for cancer has improved quite a bit,” he says. “But at the same time, the death rate has remained almost the same.”

The observation isn’t contradictory; it reflects the progress made in treating cancer without curing it. People who get cancer now live much longer thanks to early diagnosis, but they often die from its return.

Chen is a leader in a new research approach that defines a rare population of tumor cells — cancer stem cells. They are responsible for tumor initiation and return, but proliferate very slowly compared to the vast majority of tumor cells.

“All current anticancer drugs are designed to kill highly proliferating cells, and they are very effective,” Chen says. “But the root is still there.”

By developing a detailed understanding of the cellular root of cancer, Chen and other proponents of the cancer stem cell theory hope to move beyond slowing the disease to effecting its cure.
How we speak provides clues about who we are and establishes our relationships with others. While we emulate certain speakers because we admire them, we mimic others to ridicule them.

Studying just how our speech can be used for various cultural projects is one of Elaine Chun’s research goals. “My research examines how language relates to identity and culture in multiethnic America,” Chun says.

Chun’s research describes a range of language practices, including sounds and words in face-to-face conversations and Internet videos. In addition to analyzing how these practices are culturally meaningful, she examines how they reinforce or challenge understandings of race, nationality, gender and class.

“I have been particularly interested in language among Asian American youth, not only how their styling practices evoke stereotypes but also how they sometimes reshape community ideologies and values,” says Chun, who joined the university in 2007.

Chun’s peers at USC describe her as a “versatile and multifaceted scholar, using a wide range of methodologies in her research.”
Heidi Rae Cooley wants to help people understand what mobile technology means—that they are visible and “on the grid.”

“I’m most surprised by the fact that students are often very unaware of their ‘visibility,’” Cooley says. “They don’t recognize that they’re ‘on’ even when they’re posting to Twitter or Instagram or texting a friend.”

Cooley’s research investigates how the pervasiveness of mobile technology has changed behavior and how that realization might alter habits of consciousness.

“Ultimately, I am interested in the ways in which a given technology influences how we live and understand our presence — socially, culturally and perhaps politically,” she says. “We have developed new habits as a result of the new technology.”

Her latest project is a book titled “Finding Augusta: Habits of Mobility and Governance in the Digital Era” that features its own mobile application Augusta App.

“You get rewards, images, updates, posting capabilities, but also it will track your interactions and transactions and rate the degree of your participation,” she says.
When residents of London, England, established the East Smithfield Cemetery outside the city in 1348, the idea was to provide a final resting place for victims of the bubonic plague then sweeping through Europe.

Now, the bones and teeth of the more than 600 plague victims interred at East Smithfield have new life, providing biological anthropologist Sharon DeWitte unprecedented insight into the disease, which lingers even today. Studying the skeletal remains from the 14th century, and comparing those of plague victims to those of healthier people who died soon after, is also expanding the temporal scope of emerging disease research in the 21st century.

“Most of the emerging disease research today is on current diseases such as Ebola and HIV, and trying to predict where and when other diseases will emerge,” DeWitte says. “We have some idea of how these diseases affect people short term, over a matter of months, but by looking at the Black Death and at the population that survived, we can also get a better idea of the longer term consequences of disease.”
Heart attack and stroke account for one-third of all U.S. deaths, and plaques in blood vessels are the culprit.

Plaques can restrict blood flow or break free and lodge in a new location, where blood flow might be blocked completely. The formation of plaques, called atherogenesis, is a chronic process in which lipids and inflammatory cells accumulate in the arterial wall.

Daping Fan’s laboratory is developing strategies to slow it down. His group is learning how macrophages — the first line of defense against bacterial and viral infection — can become part of the problem when they are engorged with excessive lipids that cause inflammation in the arterial wall.

“Our results suggest that blocking the signaling initiated by a cell surface protein called TLR4 may be an effective approach for halting the disease,” he says. “Now, we are trying to develop a small molecule derived from a Chinese herb as such a blocker. The road will be long; it is hope that makes us enjoy every step, big or small.”
It wasn’t a long leap for Steven Harrod to shift his doctoral research on Pavlovian conditioning to his current research on prenatal exposure to nicotine. Both topics focus on factors that trigger a particular response in the brain.

“I’m particularly interested in how that affects later behavior when a person who was exposed to drugs in the womb decides to take a drug of abuse,” he said. “That person is particularly vulnerable to becoming addicted, and I’m looking into the neurobiological underpinnings for why that happens. Perhaps there are biomarkers that might reveal how vulnerable an individual might be to becoming addicted.”

Harrod teaches a popular undergraduate course, Drug Use and Effects, that explains the complexity of addiction and the intricate interplay of neurochemicals that fuel a motivational circuit in the brain that’s not unlike the drive for food or sexual behavior.

“It makes sense to talk about this with high school and college-age students. They need to know their family history because some people are at greater risk than others,” he said.
If prophets of doom have you anxious about the future of energy, just remember that scientists like Kevin Huang are on it.

In his first few years at USC, Huang has been issued one patent and eight more are pending for his energy-related research. He’s figured out how to make an all-ceramic, solid-state battery that can discharge stored energy 100-times faster than a lithium-ion battery. Once fully developed, the battery technology could be ideal for storing energy generated by renewable sources such as solar and wind.

“I’m using fuel-cell technology to develop this battery system,” said Huang, who worked on solid-oxide fuel cells at Siemens before joining the university.

He’s continuing to study solid-oxide fuel cell technology, developing better electrodes that allow the fuel cells to operate at lower temperatures and for long periods of time. He’s also created a membrane that can be used to remove carbon dioxide from the flue gas of electric generating plants. Research on those three projects is reflected in the 60 papers he’s written in the past four years. Energy challenges? No worries — Huang’s on it.
One ton of seawater from the North Atlantic Ocean arrived in Seth John’s lab in 2011.

Since then, John’s research on the ocean’s metals has delved deeper into how trace metals influence marine biogeochemistry. His lab in the Marine Science Program and Department of Earth and Ocean Sciences is one of the few labs worldwide that can make measurements of stable isotope ratios and the only lab that can measure iron, zinc and cadmium together.

“That’s been one of our big projects — making those measurements in seawater for the first time,” he says.

The international GEOTRACES project, which will soon bring two tons of seawater from the Pacific Ocean into John’s lab, is trying to understand how the oceans work and what role micronutrients play in the ocean system. The results have large-scale implications for ocean fertilization and how the nutrients might have influenced carbon fixation throughout the geologic past.

“For hundreds of years, people have understood that nitrate and phosphate are important nutrients in the oceans, but only in the past two decades have people fully understood how important these micronutrients are,” he says.
You could say Anthony Nyberg is a people person. He wants to know what makes them work and, maybe as importantly, what makes them quit.

Nyberg worked for more than a decade in financial services, including starting and growing his own firm. During that time, he found that the most important issues had little to do with finance and a lot to do with people.

“Whenever I met with peers and mentors in other businesses, every successful accomplishment — and most of the major headaches — discussed were people-based,” Nyberg says.

This realization led him to pursue his doctorate in 2003, and he has been at USC since 2008. His research examines how organizational practices affect workers and the organization. Nyberg devotes his “energy to researching the role of rewards in motivating people, and what happens when the collective efforts of those people are maximized and conversely what happens when those people leave.

“My goal is to help remind businesses that it is the human element that is most responsible for achieving sustainable success,” Nyberg said, adding, “It is imperative that we rigorously pursue identifying the policies and practices that help unite people to strive to achieve a common purpose.”
If Yuriy Pershin and his collaborators succeed, computers will function much like the human brain. To do so, they’re tackling a fundamental problem of computing.

“In current computers, information processing and storage occur at different locations,” Pershin says. “This mode of operation requires a lot of information transfer between the memory and the CPU. It is a bottleneck in modern computers.”

Pershin is at the forefront of the field of memory-computing, or mem-computing, which is focused on putting memory and computation functions in the same place. This would eliminate the transfer bottleneck and result in much more efficient computing.

He and a team of collaborators at Oak Ridge National Laboratory have recently demonstrated success, showing that a ferroelectric material can be used to simultaneously store information and apply logical operations to the data.

“Mem-computing is close to the operation of the brain,” Pershin says. “In the human brain, we do not have any physical separation between computing units and information storage units, and the brain works in parallel. This is what we’re trying to develop in electronics.”
Whenever Yan Tong has a conversation with someone or watches a movie, she finds herself making mental note of everyone’s facial expressions.

That’s because her research on affective computing involves cataloging facial expressions with the goal of programming computers to recognize certain emotions.

“This is a grand challenge task,” Tong said. “If we are successful, computers could be used to recognize signs of road rage or intoxication in automobile drivers or to help teach autistic children how to interpret and respond appropriately to facial cues.”

Previous research in affective computing has determined that facial expressions associated with happiness, anger, fear, sadness, disgust and surprise are largely the same across cultures and nationalities. Labels have been assigned to the spectrum of facial expressions associated with those emotions, then programmed into computers.

“Imagine an online instructor who is teaching hundreds of students at the same time. A computer could spot facial expressions of boredom or confusion, and alert the instructor who might then speed up or slow down the pace of the lecture.”
Nanotechnology involves fundamental units that are very small, on the order of a nanometer — a billionth of a meter.

But there’s a smaller arena still, the province of the molecule itself. Hui Wang is a leader in studying the interface between the species in these two size regimes, which interact with each other in sometimes-unexpected ways. As a doctoral student, he worked with plasmonic nanoparticles. As a postdoctoral fellow, he studied single-molecule spectroscopy.

“That is why I’m trying to combine research on both molecules and nanomaterials here, to look at the interface,” he says. “We are doing curiosity- and hypothesis-driven research.”

Potential applications for such fundamental inquiries have a wide scope, and his team has already shown progress that could prove useful in early detection of cancer. Using a specially designed electrochemical nanoprobe, they are able to discriminate between normal cells and cancer cells from the biomarkers expressed on the cellular surfaces. The probe is so sensitive that it can detect as few as four or five cells.
Jun Zhu is working to find solutions to a newly recognized challenge in treatment for HIV-associated brain damage.

“Over the past decade, people have come to see HIV as well controlled,” he says. “And it’s true that infected patients live much longer. But over the next century we face a new problem.”

That problem is NeuroAIDS. About one-half of HIV-positive individuals have minor or major brain damage. “It affects memory, learning, decision-making, planning,” Zhu says.

For a long time, the idea of the virus crossing the blood-brain barrier was not even considered, but it’s now clear that HIV viral proteins are released in the brain where they disrupt normal brain functions.

Zhu has established an NIH-funded research project to investigate how HIV viral proteins disrupt the human dopamine transporter, a critical protein in the regulation of dopamine neurotransmission. “The ultimate goal is to develop neuroprotective drugs,” Zhu says. “We want to help HIV patients recover their neurological function.”
Successful graduate students are the lifeblood of a top-tier research university, infusing the campus with energy and inquisitiveness that helps create a vibrant learning environment. The University of South Carolina’s 2014 Breakthrough Graduate Scholars epitomize these qualities. Their participation in the life of the university raises the bar for everyone.
This year’s cohort of Breakthrough Graduate Scholars include doctoral students from myriad academic disciplines, including engineering, health, business and arts and sciences. A brief synopsis of each scholar’s accomplishments follow.

**ROBIN DAWSON ESTRADA**  
**PH.D. IN NURSING**  
College of Nursing

- conducting groundbreaking study of interpreter-mediated health care interactions between nurse practitioners and limited English speakers
- co-author of two publications; one in press

**MICHAEL CHANCE**  
**PH.D. IN INORGANIC CHEMISTRY**  
College of Arts and Sciences

- developer of novel approach to growing crystals not attainable by other methods
- author or co-author of seven publications
**AMIRA OSMAN**  
**PH.D. IN HEALTH PROMOTION, EDUCATION AND BEHAVIOR**  
Arnold School of Public Health  
- Fulbright Scholar recipient 2010-12  
- author or co-author of five publications; two manuscripts in preparation

**STEVEN BELLOMY**  
**PH.D. IN ENGLISH**  
College of Arts and Sciences  
- recipient of the Richey Award in American Literature and a fellowship to the Folger Shakespeare Library  
- essay published in Palgrave’s *The New Urban Atlantic Series*

**CLAIRE ROBINSON**  
**PH.D. IN EDUCATION ADMINISTRATION**  
College of Education  
- author or co-author of six publications and co-author of book on teaching and learning  
- recipient of Outstanding Freshman Advocate Award from National Resource Center for the First-Year Experience and Students in Transition
FRED TABUNG
PH.D. IN EPIDEMIOLOGY
Arnold School of Public Health

• recipient of the NIH Ruth L. Kirchstein Individual National Research Service Award
• author or co-author of three publications; four more in preparation

PAUL REED
PH.D. IN LINGUISTICS
College of Arts and Sciences

• writing first detailed sociophonetic analysis of Appalachian English
• presented at 14 scholarly conferences

JENNIFER MCLEER
PH.D. IN SOCIOLOGY
College of Arts and Sciences

• recipient of a National Science Foundation Dissertation Award
• author of two publications
CHAZ YINGLING  
PH.D. IN HISTORY  
College of Arts and Sciences  
• author of two publications and one book chapter  
• recipient of university’s Presidential Doctoral Fellowship

FRANK MAY  
PH.D. IN MARKETING  
Darla Moore School of Business  
• author or co-author on two publications; several more papers completed  
• 2013 recipient of Moore School of Business Promising Researcher Award

CAROLE SOX  
PH.D. IN HOSPITALITY MANAGEMENT  
College of Hospitality, Retail and Sport Management  
• winner of three competitive awards for teaching, research and leadership potential  
• named Adjunct Teacher of the Year in School of Hotel, Restaurant and Tourism Management
ADRIAN GOMEZ  
PH.D. IN PHARMACOLOGY  
S.C. College of Pharmacy  
- author or co-author of six publications; one manuscript in preparation  
- awarded first place for oral presentation at S.C. College of Pharmacy’s graduate student retreat for USC and MUSC campuses

TRAVIS JOHNSTON  
PH.D. IN MATHEMATICS  
College of Arts and Sciences  
- author or co-author of three publications and three submitted  
- awarded third place in national Cryptoanalytic Literature Competition

XIN CHEN  
PH.D. IN MECHANICAL ENGINEERING  
College of Engineering and Computing  
- author or co-author of 14 publications  
- presented at 12 scholarly conferences