LSU RESEARCH

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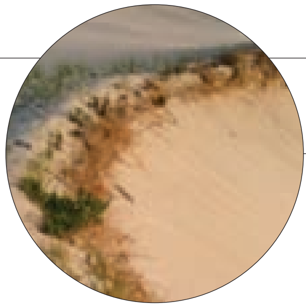

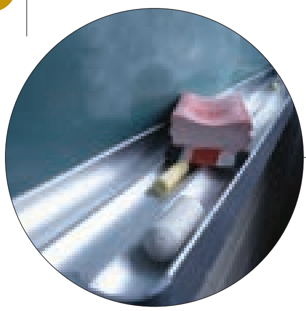

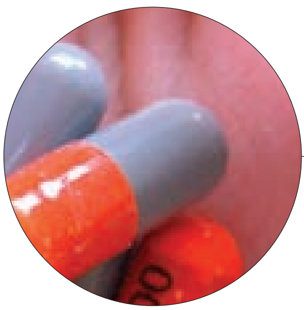

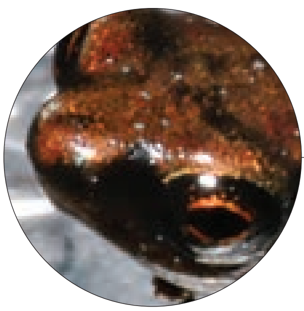

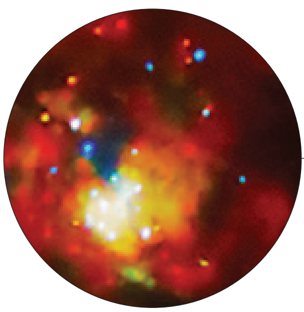


The Clean Room at CAMD. Read more about the innovative research in materials science going on at the university on page 32.

LSU RESEARCH

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LSU Research

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As Louisiana's comprehensive Flagship University, LSU has a diverse portfolio of internationally recognized scholarly programs covering the arts and humanities, social and behavioral sciences, science, engineering and medicine. These are housed in 11 colleges and 66 departments across the campus. LSU is also a Land Grant, Sea Grant and Space Grant institution. Our research mission appropriately spans the range of basic and applied studies and continues to have a direct impact on the economic development of the state and region. While individual and small group research programs remain central to our effort, like most research universities, we have identified areas of focus based on our strengths, which cross departmental and college lines and have some unique significance to our strengths, mission and the region. In general terms, these areas in the sciences are coastal and environmental sciences, conventional and renewable energy, computation and high performance computing, materials science and engineering, and areas in biological and biomedical science. In the humanities and social sciences, the focal areas include individual behavior and community context, and communication and expression – the scientific, humanistic and artistic dimensions of the human communicative experience and how they intersect with and augment in novel ways the process of discovery in science and engineering.

In the recent past Louisiana has suffered from budget shortfalls which have translated into severe cuts in funding for higher education. Natural disasters such as hurricanes Katrina, Rita, Ike, Gustav and most recently Isaac have also impacted the state and proven challenging for LSU. The Deepwater Horizon drilling rig explosion and related oil spill brought further catastrophe to the Gulf Coast. These challenges, however, have resulted in an outpouring of activity from our faculty, further invigorating their research programs and fostering a renewed recognition of their long-standing expertise in these areas.

While these events brought challenges, LSU's research enterprise has benefited from several recent infrastructural additions with help from our supporters and the state. Specific examples include a five story, 85,000 sq. ft. Chemistry and Materials building; a three story 35,000 sq. ft. Digital Media building to house our Center for Computation and Technology; SuperMike II, a new high performance computing system improving our computing capacity 10-fold; a 54,000 sq. ft. Animal Diagnostic Center addition to the School of Veterinary Medicine; a new 156,000 sq. ft. Business Education Complex; and a new expanded physical model of the Mississippi River. In addition, a new public-private partnership of $100 million has been agreed to for the renovation and expansion of the Patrick F. Taylor Hall for Engineering. Taken together, these investments set the stage for LSU to remain at the forefront of scholarly achievement in the decades to come.

The current issue of LSU Research includes articles on studies that touch on some of our diverse and important research programs and faculty. I hope you enjoy this issue, and for more information on our activities please visit the ORED web site http://research.lsu.edu/.

Thomas R. Klei

Interim Vice Chancellor, Research & Economic Development
Boyd Professor, Pathobiological Sciences

Patrick Hesp, R.J. Russell Professor in Geography and Anthropology in the College of Humanities & Social Sciences, is one of a select few scientists in the world who have dedicated their lives to studying coastal dune morphology, dynamics and evolution.

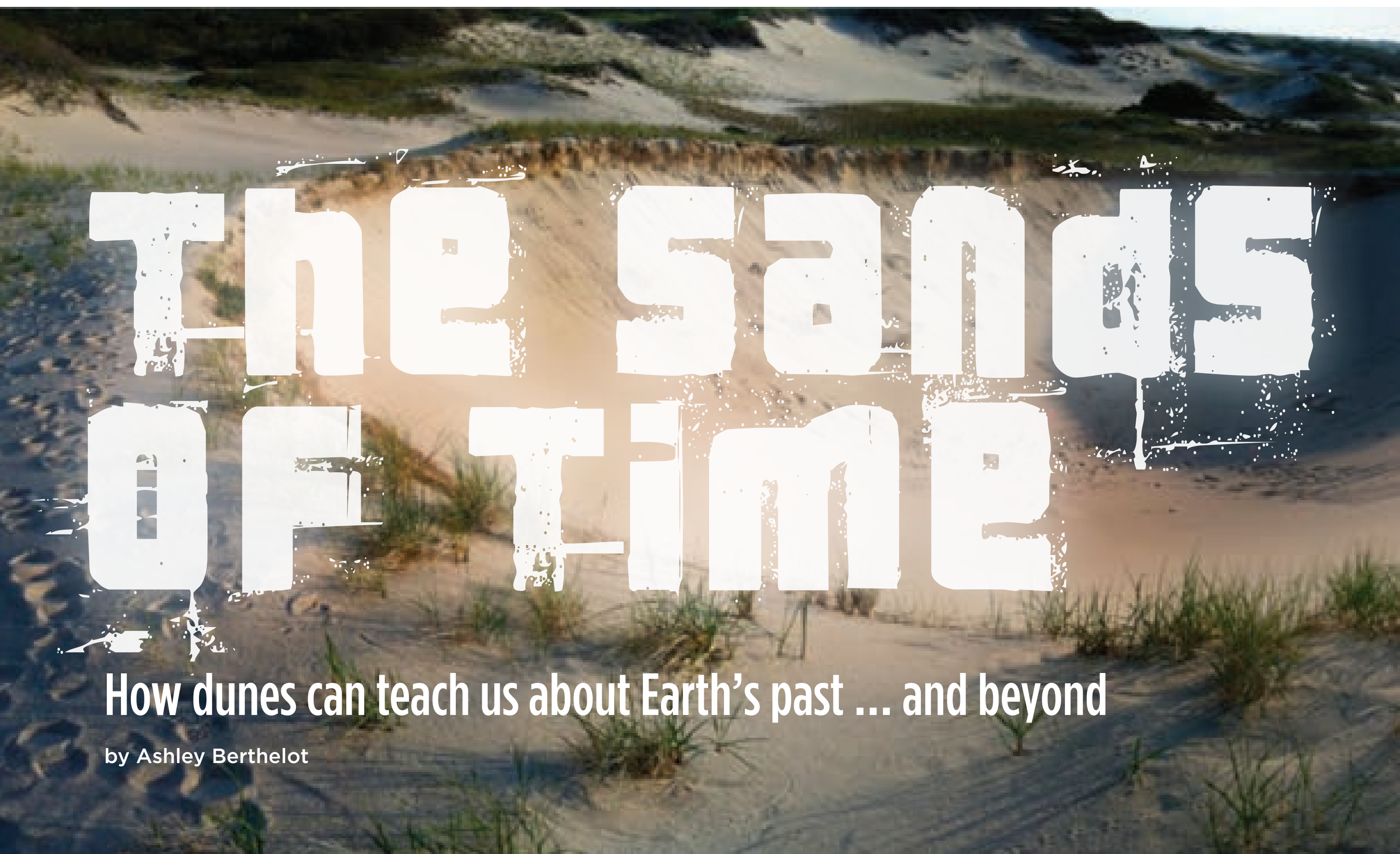
"Essentially, when compared to other fields of science and their overall knowledge of the basic systems they study, coastal dune geomorphologists are stuck somewhere around the '70s," Hesp joked. "But when you look at how much of the planet is covered by these dunes – deserts, beaches, etc. – you'll understand how important their evolution is."

Hesp has studied dunes in just about every climate and location you can imagine, from cold winters in Cape Cod to the oppressive heat of an African summer. He has done research on the island of Sardinia and along the coast of China. Dunes are truly a global phenomenon, and studies on their dynamics and evolution and the impacts of humans could have significant lessons for coastal conservationists.

Change is especially important in coastal dune areas, where the concept of global climate change has serious implications for the future. What will happen if sea levels continue to rise? Thanks to researchers like Hesp, we now have some level of predictive capability.

"Though we tend to think of dunes as primarily being in temperate to sub-tropical locations, they occur all over the world, even into the Arctic and Antarctica," said Hesp. "In these environments their processes are completely different. They are covered in ice and snow for most months of the year and thus sheltered from the impacts of wind and erosional forces. It's important to learn the differences as well as the similarities between dunes across the planet."

His overall research program focuses on three major aspects of dunes and dune geomorphology, ranging from the macro- to microscale.



The Sands of Time

How dunes can teach us about Earth's past ... and beyond

by Ashley Berthelot

"Basically, I study everything that happens in and on some dune types and systems, in increments of time ranging from every 30 seconds to a minute or so (e.g. instantaneous wind flow and sand transport over a dune), then in five to 30 years (e.g. examining historical aerial photographs to see how a dune evolves over time), and then, on the big end of the scale, what has happened over the last 7,000 years or so to see how entire dune systems have evolved," he said. "In this way, we hope to eventually have a full understanding of all working aspects of these systems."

The three broad categories of his research include:

- **Windflow, sand transport and aerodynamics over dunes**. In other words, how does a particle of sand move in the wind and how do they collectively form dunes?
- **Sediment supply and survival of systems**. This area of research focuses on Florida, where you might have an area recognized as one of the fastest eroding coastal locations in the world sitting almost directly across the street from a location recognized as one of the most erosional. "It's all about sediment supply in these cases," said Hesp. "How are these landscapes created and sustained?" There are also many useful applications to barrier islands in places susceptible to hurricane damage, such as Louisiana and Florida. What are the relationships between wind energy, sea level and sediment supply? Can we understand these interactions and use this knowledge to our benefit?
- **Dune evolution**. How has the whole system evolved over time? What are the evolutionary steps that lead from one stage to the next, and sometimes back again?

"Overall, we're getting to a point where we can understand enough about flow over certain kinds of dunes so that we can use computer models to extrapolate processes and patterns," said Hesp. "But, I don't believe in using models unless you really understand the basics driving the systems, and we [as a field of science] generally aren't at that point yet for most dunes."

Although there are many researchers focusing on Aeolian, or wind-related processes, most are focused on dust erosion specifically. According to Hesp, there are less than 10 researchers around the world committed to full time study of dunes in coastal regions. Because it is such a rare field, the level of instrumentation is lacking as well.

"We're moving toward a better scenario, but it wasn't so long ago that a single wind anemometer cost around $20,000, and you need several to develop a really thorough look at a single sand dune or blowout," said Hesp. "Recently, prices have become much more

Hesp's goal is to develop a thorough understanding of a dune's environment, which is dependent upon knowing how wind impacts the formation.

reasonable, and we're slowly increasing the amount and quality of data we can gather."

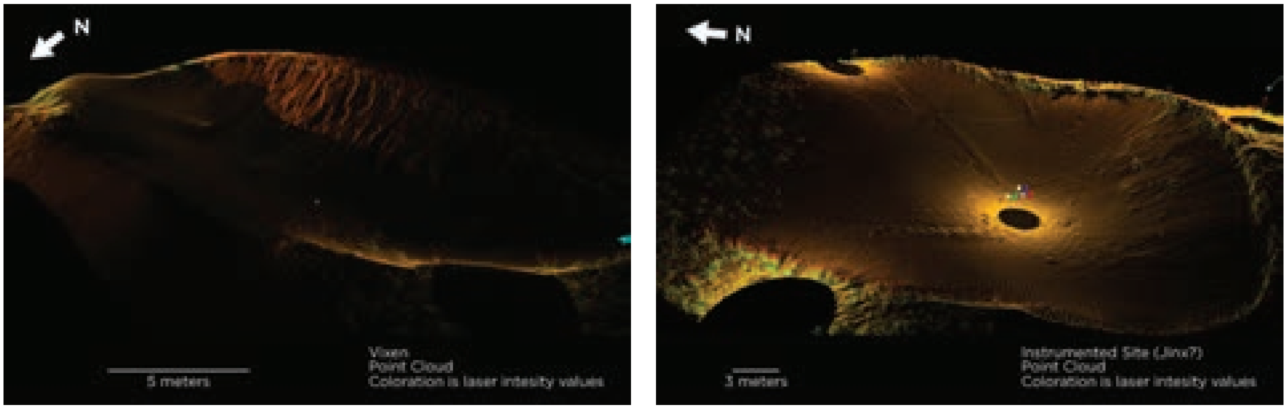
In order to get a thorough picture of a dune environment, Hesp's group works with a few specialized pieces of equipment. First, they use two different kinds of anemometers: cup and sonic anemometers. The sonic anemometers are quite advanced and measure instantaneous wind flow in three dimensions.

Cup anemometers are a little less sophisticated, but still useful. Essentially, they are small cups attached to fixed, horizontally-oriented arms that can move with the wind, measuring its overall speed.

"These are the ones you see on the Weather Channel," joked Hesp, "or on old tornado movies."

Also used are sand traps, which quite literally trap sand blown into them from wind movement, and an advanced piece of equipment called a "wenglor," which is a three-sided instrument measuring sand and sediment movement with a laser beam. As sand grains are blown through the wenglor, the device measures the actual

A typical day in the field for Hesp's team includes setting up a wide variety of instruments to measure wind direction and speed as well as the movement of sand.



Lidar imaging provides high resolution, 3-D images of a dune's topography, allowing researchers to track growth or movement to the millimeter.

numbers of sand grains passing through the laser. This piece of equipment was originally designed for use in pharmaceutical assembly lines to measure how many pills were produced during a set amount of time.

The most sophisticated tool in Hesp's arsenal is known as a ground-based lidar. It sweeps the dune or blowout with 24 million laser points per scan to produce a 360-degree high resolution, 3-D image of the dune's topography. This process used to take days with conventional surveying instruments, but now takes only minutes with the lidar.

"These lidar models and images are amazingly accurate," said Hesp. "Every six months or so, we take it back to the places we've previously modeled and we can measure even millimeters of change."

Basically, Hesp has found that if a dune system has a continuous feed of sand and sediment supply and room to move, it can out-compete sea level rise and sometimes even continue to grow. It's a complicated issue, however, when you consider that more than half of the U.S. population lives in coastal areas.

"When was the last time you saw large amounts of open space on a USA gulf coast or east coast sandy beach?" Hesp asked. "Most of our room to move in this area is taken up by housing and condo development. So that ability [for dunes] to react to and survive global sea rise is severely compromised in most cases, and we need to figure out how to handle that fact."

Hesp was recently awarded a Fulbright grant to conduct a detailed drilling and dating program for three months on two coastal barriers in Brazil, one at Pinheira in Santa Catarina State and the other at Paranagua in Parana State. These locations are important because they contain suites of two completely different dune types that regularly alternate across the coastal barriers. At Pinheira, for example, there are suites of foredunes, which are dunes formed by sand deposition by wind in plants on the back of the beach that generally indicate stable, or non-erosive, conditions. These alternate with groups of parabolic and blowout dunes, which generally indicate erosional conditions.

The alternation of one type of dune to another indicates a strong, regularly repeating change in climate or coastal storms. Therefore, dating these episodes may provide a detailed record of climate and coastal change over the past 7,000 years. There are important connections with Louisiana and the United States because these climatic changes operate over very significant distances across the globe, and an understanding of their timing will assist in understanding how the Louisiana coast has changed over time and what the climatic drivers are for coastal change.

The study holds implications for climate change, as these dunes are relatively easy to disturb and many climate models predict a drier, more arid future.

In fact, the work Hesp does isn't only relevant to the study of our own planet's workings, but may help us to understand some of the phenomena found on others. Together with United States Geological Survey scientist David Rubin, Hesp recently published a paper in *Nature Geoscience*, "Multiple origins of linear dunes on Earth and Titan," which examined a possible new mechanism for the development of very large linear dunes formed on the surface of Titan, Saturn's largest moon.

They examined the linear - or longitudinal - dunes that stretch across the surface of China's Qaidam Basin, finding them composed of sand and some salt and silt. The latter two elements make the dunes cohesive, or sticky. According to the study, this leads to a complete change in dune form from transverse dunes to linear dunes, even though the wind speed and direction does not change. Typically transverse dunes are formed by winds from a narrow directional range while longitudinal or linear dunes are formed by winds from two obliquely opposing directions. These findings offer an alternative interpretation of similar dunes found on Titan.

Hesp and Rubin suggest that if the giant linear dunes found on the surface of Titan are also formed from cohesive sediment, then they could also be formed by single-direction winds. This is in sharp contrast to earlier studies, which assumed that the sediments were loose and interpreted the dune shape as evidence of winds coming from alternating directions. The alternative hypothesis that Titan's linear dunes are formed in cohesive sediment has significant implications for studies on wind transport of sediment, characteristics of winds and overall surface wetness. If the Hesp and Rubin alternative is correct, new hypotheses will have to be developed for all of these characteristics.

Despite his extraterrestrial line of research, Hesp would rather be working on the coast of Western Australia, contrary to his New Zealand roots, than anywhere else in the world.

"In terms of a laboratory, the coast of Western Australia has every type of dune, wind speed, beach type, tidal range and anything else you'd ever want to study," he said. "And it's mostly uninhabited, so it's the closest thing to a real-life lab experiment you'll ever get."

Coastal Roots

"The overarching goal of the LSU Coastal Roots Program is to engage our participants, both teachers and students, in learning about critical issues facing Louisiana's coast and natural resources," said Pam Blanchard, LSU College of Human Science & Education associate professor. "We are very fortunate to work with very dedicated teachers interested in providing their students this opportunity to learn about these issues and to help protect and restore these habitats by growing and transplanting native plant species."

Fast facts about Coastal Roots:

- Started with six schools in 2000 as a project of Louisiana Sea Grant College Program
- 40 schools across 19 parishes
- More than 74,000 student-grown native plants transplanted on 187 trips
- More than 8,600 students in grades 2-12 participated in the trips, with 500+ teachers and 800+ chaperones.
- Co-directed by Pam Blanchard (associate professor of science education in the School of Education) and Ed Bush (associate professor of horticulture in the School of Plant, Environmental & Soil Sciences)
- Current funding through a NOAA Bay-Watershed Education and Training grant and dedicated gifts through the LSU Foundation

To view a Coastal Roots photo gallery, scan this QR code on your smart device.

We are told about the importance of education from birth. Our futures, according to most parents, are solely dependent upon the accomplishment of a variety of different goals, starting with niceties like piano lessons and extra-curricular activities. The high school diploma rests at the center of this universe of achievement. But what most of us don't realize is that the lack of a diploma isn't just an obstacle toward becoming a doctor, lawyer or scientist — it might also serve as a gateway to criminal activity.

"There's just a huge relationship between dropping out of school and becoming involved in criminal behavior," said Cecile Guin, director of LSU's Office of Social Service Research & Development, or OSSRD. Guin and her team of dedicated colleagues have made it their mission to look at the life "pathway" of a Louisianan who drops out of school versus one who stays in the state's school system.

Since the 1980s, Guin has taken a keen interest in children in the Louisiana juvenile justice system. While writing her dissertation, "Juvenile to Adult Criminality in Louisiana," Guin's interest was sparked, and she knew keeping children in school was an issue that needed the state's attention. Her passion led directly to the development of the Louisiana Dropout Study, or LADS, and the Truancy Assessment and Service Center, or TASC.

LADS is in phase one of the eight-phase Louisiana Pathway Study, which aims to demonstrate the cost effectiveness of the TASC program using a massive database, collected since 2000, of more than 80,000 high-risk students. LADS, which is ongoing, focuses on a sample of dropouts and graduates involved with the Louisiana Department of Corrections, DOC. The goal is to explore the relationship between criminals in the DOC and their educational history, and to make citizens aware of the economic impact dropouts have on the state.

According to Guin, the study collected data from the DOC, the Department of Education and the Office of Juvenile Justice from 1996 to 2008, which included approximately 1.8 million children. From those 1.8 million, Guin and her colleagues selected and researched a 10-year cohort.

The information LADS discovered from the selected cohort was no surprise to Guin. Forty-seven percent of the individuals examined in the Louisiana DOC were Louisiana public school dropouts. Six times as many incarcerated inmates were dropouts compared to graduates.

Moreover, research from the LADS study demonstrated a strong correlation among early truancy, academic and behavioral problems in school, dropping out and the development of delinquent behavior. As a result, Guin, in conjunction with other researchers from the LSU School of Social Work, began to develop the TASC program.

In conjunction with the LSU Division of Economic Development, they created three life history charts, which followed three children who were involved with the DOC. Each chart demonstrated the child's risk factors, such as gender, race, poverty and expulsion, how many school days the child missed, his/her criminal involvement and how much it cost for that child to stay in the DOC. Once these children reached adulthood, two were sentenced with the death penalty and one was sentenced with two life terms.

Guin and her colleagues presented these findings to the Louisiana Legislature. In 1999, state lawmakers passed the TASC legislation to help combat truancy among students in kindergarten through the fifth grade, and as a result, two pilot TASC programs were created. The program was developed as an aid to keep Louisiana students out of the justice system by helping them stay in school. According to the TASC Planning Guide, the program's purpose is "to provide early identification and assessment of truants and the prompt delivery of coordinated interventions to prevent continued unauthorized school absences."

Since then, the TASC program has handled nearly 100,000 student referrals, and each year, the program serves more than 12,000 students and their families. In the 2010-11 school year, the number of unexcused absences declined 27 percent, and 76 percent of TASC students had improved attendance. According to Reneé Boutte Myer, assistant director of OSSRD, only 3 percent of TASC cases ever reach the court system.

At one point in time, there were 21 TASC sites across the state. However, recent budget cuts affected the program's growth, leaving only 14 current TASC sites to serve 21 parishes and more than 300 Louisiana public schools. Despite its success, the program was facing a crossroads: How would they gain the critical support needed to continue?

Then, in December 2010, Dek Terrell, director of the LSU Division of Economic Development, suggested to Guin and her department that they explore the economic impact of dropping out of school in Louisiana to prove the effectiveness of the TASC program.

"While conducting the study, we felt like if we really focused on graduates versus dropouts, and not even talk so much about the crime aspect, that it would point out how much it really does cost the state when kids do not stay in school," said Guin.

According to research results, a Louisiana high school dropout who turns to a life of crime costs the state $1,686,816. If the number of students who drop out was lowered by 10 percent, the state would save more than $7 million annually. Ultimately, TASC would only need to prevent 12-13 children from dropping out of school, or achieve a success rate of 0.11 percent annually, to justify its cost to the state.

Stephen Barnes, assistant professor in LSU's Department of Economics and associate director of the Division of Economic Development, played a key role in the economic research of the study.

"What we were looking to do was to help out with the study to an extent to see how big of an impact TASC could have on the juvenile justice and corrections system. Our goal then was to translate that impact into a dollar value to see if it gives back to the state," said Barnes. "From a state budget perspective, we've found that TASC is a very good investment. By putting money into a program like this, the state gets money back, and then some."

The strong success-rate of the TASC program has led to the development of the Family and Youth Service Center, or FYSC, which will now house the East Baton Rouge Parish TASC site. The goal of the center is to provide help for a wide range of problems with children and families in one place. East Baton Rouge Parish District Attorney Hillar Moore spearheaded the idea of FYSC.

"The mission of the center is to identify children who exhibit truant tendencies, assess the problems for these tendencies and provide access to services to these families to eliminate these problems," said Moore. "Our goal is to have staff partners from various programs work together to attain the best solutions for the family's needs."

The center, which has been referred to as a "one-stop shop" by Guin and her colleagues, will provide help from the Louisiana Department of Family Services, the Louisiana Department of Health and Hospitals, the Louisiana Department of Education, the Louisiana Office of Juvenile Justice and the Louisiana Workforce Commission.

As for the future of the Pathway Study, Guin and her colleagues have big plans. One of their main goals, which is currently in the works, is to have data automatically transferred to them from various agencies every year, so they can provide the state with an annual report describing patterns in the pathways of Louisiana children, and determining whether there is an increase or decrease in DOC involvement or dropout rates.

In addition to the annual data already being used for the study, Guin would like to get more information from the Department of Child and Family Services to see how many of the children researched as dropouts or graduates were abused or neglected, and how many of those children's families are on public assistance. Additionally, the office would like to provide geographical information for Louisiana regions and parishes so these areas can compare and contrast dropout rates in order to improve what is lacking in their area and, ultimately, the state as a whole.

In regard to the economic goals for the study, Barnes is currently working to get Louisiana Workforce Commission data to determine the difference in employment records between dropouts and graduates.

"The point of this office is to continually track the pathway of Louisiana children in hopes that we can get something accomplished," said Guin. "I think the creation of TASC has accomplished a lot, and that it has definitely shown the difference between staying in school and not staying in school for these children. It has been very rewarding to implement a program and know that we are making a difference in the lives of some children."

Scan the QR code on your smart device to access a copy of the original study .

Project BRAVE

by Cathy Juarez

Funded by a $1.5 million grant from the Office of Juvenile Justice and Delinquency Prevention, the Baton Rouge Area Violence Elimination Project, or Project BRAVE, aims to reduce the high crime rates of Baton Rouge by targeting the high crime zip code of 70805, which houses a population of 31,000 people and serves as the city's epicenter of violent criminal activity. To do so, LSU criminologists joined forces with city government and local police to attack the problem from all angles.

Under the supervision of the Mayor and District Attorney's office, Project BRAVE seeks to "change community norms towards gang and group violence, provide alternatives to criminal offending by the targeted group and alter the perception of youth regarding risks and sanctions associated with violent offending."

Decades ago, the 70805 zip code area was comprised of inner-city neighborhoods that were originally constructed as residential communities for workers employed at the nearby chemical plants along the Mississippi River. In the 1960s and 1970s, many of these residences were abandoned as workers began to move to more modern suburbs. Now, these communities, which were left behind economically, contain some of the poorest neighborhoods in Baton Rouge. Consequently, many of the youth in this area turn to violent crime.

Short-term outcomes of Project BRAVE include increased informal social control and police effectiveness, and intermediate program outcomes include reduction in crime and diverting youth into productive activities.

Zip code 70805 was selected as the target area for Project Brave due to its central location and high rates of violent, group-related crime. This area alone accounts for 30 percent of the city's homicides. Shockingly, Baton Rouge's homicide rate, 30.1 per 100,000, exceeds the homicide rates in New York, which is 6.6 per 100,000, Los Angeles at 7.7 per 100,000 and Washington D.C. at 21.9 per 100,000.

In addition to homicides, the offenders living in this target area commit 25 percent of Baton Rouge's robberies, 30 percent of assaults with firearms and 40 percent of all aggravated assaults. The violence in these neighborhoods is generally related to poverty, residential instability and a lack of social cohesion among the residents.

According to the BRPD, there is an increasing problem within the 14-17 year old range, who are generally multiple offenders. Project BRAVE will implement a Group Violence Reduction Strategy, or GVRS, to aid in reducing violent crime. The GVRS model aims to limit opportunities in which members of this community can commit crime, and provide alternatives to violent behavior.

The BRPD has identified 190 youths in 70805 who are the serious, chronic, and violent youthful offenders being targeted by the proposed GVRS model.

Approximately a half dozen faculty from LSU are involved in this effort, providing analytical and statistical support to local law enforcement efforts to curb violent crime in select Baton Rouge communities.

The Clock is

by Ashley Berthelot

Most of us have taken some form of prescription medication before. But have you ever stopped to wonder how the pill that eases your symptoms, heals your heart or takes away your headache came about? You might be surprised to find that, at least in the case of one new diabetes treatment called Cycloset, the cessation of symptoms can be traced back to a lab at LSU.

Nearly 30 years ago, Albert Meier was a professor of zoology at LSU, and Anthony Cincotta was one of his new graduate students, trying to find his calling in life.

"I started graduate school at LSU in the '80s and changed departments a few times before finding Dr. Meier," Cincotta said. "I met him when I was trying to locate a professor with an endocrinology background to help me with work I was doing in plant research in the agronomy department."

However, after only a brief conversation with Meier, the work held a deep fascination for Cincotta. He joined on as one of Meier's graduate students and soon thereafter launched his career.

"Meier was looking at things in biology no one else was looking at during those times … biological clocks and circadian rhythms governing non-sleep-wake cycle physiology … All these were relatively new concepts in the early '80s, and no one yet knew how to apply them biomedically," he explained. "Meier broke new ground."

Circadian rhythms, basically explained, are the 24-hour cycles of biological activities that regulate everything in life from sleeping patterns, metabolism, immunity and reproduction cycles to seasonal migrations and hibernation patterns.

"We realized early on that perturbations to biological clocks could precipitate disease," said Cincotta. "So, if you can understand how these natural cycles operate to maintain health, you should be able to adjust and influence them and even control them when they become disrupted to thereby treat disease."

Because these biological rhythms are so closely tied to the regulation of metabolism, it wasn't a huge stretch for the researchers to consider applications to diabetes.

Ticking

"In the wild, animals develop what's known as seasonal diabetes, because most don't have access to sugar during the winter, which they need to survive," he explained. "Consequently, their bodies have a mechanism to produce their own sugar by becoming insulin resistant, a hallmark of type 2 diabetes, thus allowing their liver to produce more sugar that is shunted to the brain as a fuel source while the body runs off of stored fat."

What's especially interesting about seasonal diabetes in animals is the very fact that it's seasonal – animals are able to "cure" themselves of this insulin resistance annually. This realization led researchers to look at the disease in a completely new way: What if diabetes wasn't a defect after all, but rather a manifestation of a survival strategy that is turned on and off in animals, but doesn't do so in humans anymore because of "westernized" environmental stresses like poor diet and lifestyle acting on the biological clock to disrupt it?

"Looking at the disease that way unveiled a new approach to treating the disease," said Cincotta. "Dr. Meier had already determined many biological principles organizing these biological clocks, and we began to apply these principles to investigate seasonal insulin resistance in the lab. Once we took this approach, we were able to identify important aspects of neuroendocrine cycles that regulate metabolism and move forward with applications."

Basically, Cycloset works by delivering a rapid pulse of dopamine activity to the brain to offset insulin resistance stimulated when the natural peak of dopamine at the biological clock (suprachiasmatic nuclei of the hypothalamus) is disrupted and reduced. By adjusting aberrations in the body's natural circadian rhythms, one may be able to treat many pathologies of type 2 diabetes beyond hyperglycemia and pre-diabetes, as well.

However, taking research results and then developing medicines from these investigations is not a simple – or inexpensive – task.

"The drug discovery process is an incredibly complex process that takes, on average, about 10-20 years to complete," said Pete Kelleher, associate vice chancellor for LSU's Office of Intellectual Property, Commercialization & Development, or OIPCD. "Many drugs fail along the way, and even more never get off the ground."

Early on, Meier and Cincotta submitted an invention disclosure to OIPCD detailing their discovery. With that in hand, university commercialization representatives were able to evaluate the technology and proceed with obtaining patents protecting the university's ownership of the technology. One of OIPCD's missions is to identify companies to develop and market products covered by patents under an exclusive licensing arrangement.

"Intellectual property offices, like OIPCD at LSU, are set up to identify opportunities to expand what researchers have done in the lab into commercially-available products or services," said Kelleher.

In some cases, a new technology is appropriate for starting a new company. Such was the case with the technology developed by Meier and Cincotta. Once they realized their discoveries could be marketed, the duo started a small company called Ergo Science. LSU subsequently negotiated an exclusive license to the technology granting Ergo the rights to develop and market the new drug.

Together, Meier and Cincotta approached the federal Food and Drug Administration, or FDA, the first step along a bumpy path toward approval. Before research toward producing drugs can even begin, researchers must fill out what is known as an IND – an Investigational New Drug Application, which allows the FDA an opportunity to consider the plan and determine if they'll allow the researchers to proceed toward human testing sometime in the future. Once this approval was gained, the scientists were faced with one of the biggest hurdles in a path strewn with giant obstacles: fundraising.

Current estimates of the cost to take a drug from concept to market run at approximately $1 billion. Add to that fact the probability that any return on investment will a) usually take many years, b) be contingent upon demonstrating efficacy and safety to a high degree of certainty and c) require getting FDA approval, and scientists have got themselves an extremely tough sell.

Also, while fundraising to move the drug forward, the company must secure patent protection which is an expensive, time-consuming and difficult process.

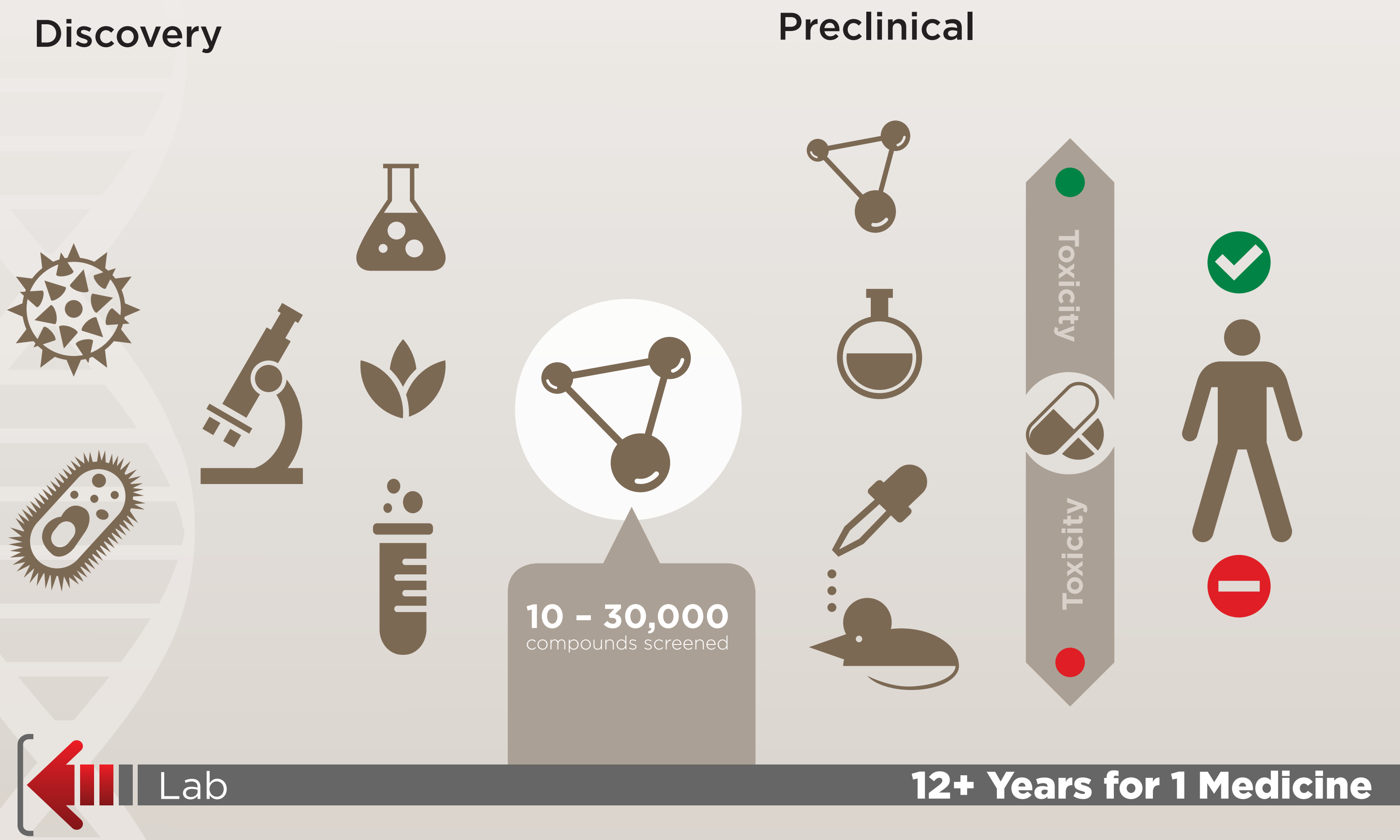
"One thing that makes our company, Veroscience, so special is that we only have 15 or so employees/consultants," said Cincotta. "And this number is far smaller than that of the typical pharmaceutical companies conducting such drug development. We have been very fortunate to be able to advance this research to the level of FDA approval, and it was not done alone. Any endeavor such as this requires the input of information gathered from countless scientists over decades if not centuries, really."

Before the approval of an investigational new drug, or IND, pre-clinical toxicology, or animal testing, is required along with much detailed information on the drug chemistry as well as pre-clinical results on the efficacy of the drug. Then Phase I, or small-scale human safety testing, is next, followed by Phase II, which tests efficacy on slightly larger groups of human subjects, concluding with Phase III, which looks at groups of several hundred or more people at once. And at the end of all this work, the FDA can say no to approval, effectively ending the drug's chance of ever making it into the market. Yet somehow, Cycloset – and Meier's and Cincotta's dreams – survived the process.

But this isn't a story of simple hard work – this is a story of the little engine that could, of perseverance and sometimes just plain old good luck.

The new company devoted significant effort and money into developing and refining the manufacturing process and development of the new drug in anticipation of conducting clinical trials under a new drug application, or NDA. But then, what seemed to be the worst-case scenario possible happened: The FDA rejected their application after decades of effort put into the drug development process. The company's board decided not to pursue the drug any further, unable to see any possibility of reviving the process to gain approval.

But because the science driving the drug was so sound and revolutionary, they were able to overturn the FDA rejection within just a few months. Once this happened, Cincotta left Ergo and started Veroscience, which, with the help of LSU OIPCD, assisted Ergo in selling the drug to



a large company; however, that company was bought out within just a few years.

"At that point, we were exceptionally lucky. We were able to buy our discovery back from this company, which is another extremely rare occurrence, and take the drug through the final stages of the FDA approval process," said Cincotta.

Now, 30 years after the initial experiment conducted by Cincotta in Dr. Meier's lab at LSU, the drug is completely FDA-approved, having surpassed FDA requirements at every turn, and is on the market for consumers.

"There are a multitude of activities involved in developing drugs that people likely don't realize," said Cincotta. "Business – you have to be able to secure large amounts of funding. Basic science – you have to have produced ground-breaking research results that allow the opportunity for a new therapy to come to light. Toxicology – you have to know that what you're producing is safe. Patent protection – you have to secure exclusivity for your product and a viable business behind it. Manufacturing – you have to be able to make the drug on a large scale. And then there is the actual marketing of the drug to the public. It's truly a massive undertaking for a company of any size."

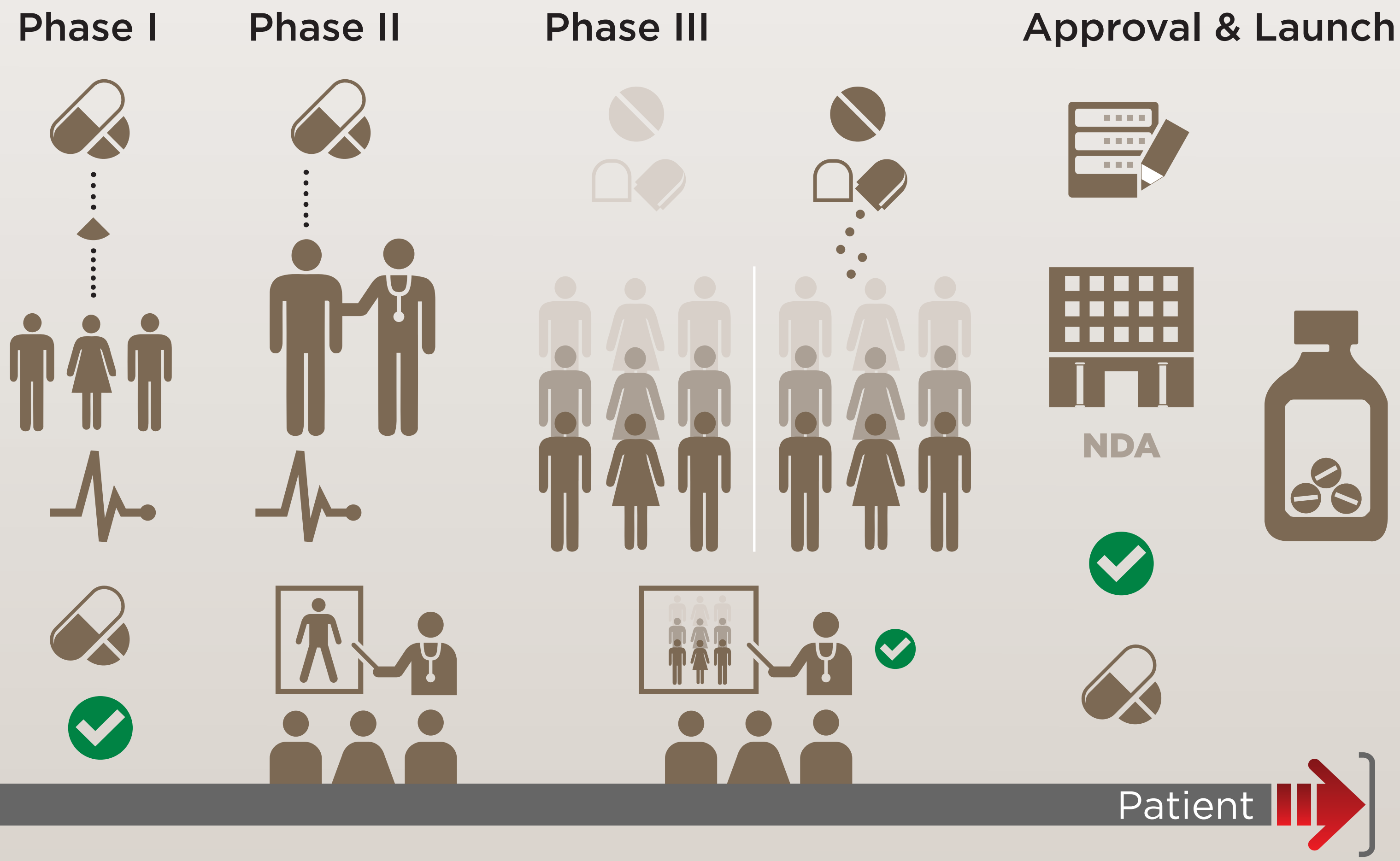
"That being said, Veroscience is truly an anomaly. It won't happen this way often. We are the exception that proves the rule," he said.

But don't forget that it's not just luck that brought Veroscience to the light of day – it was tenacity, as well.

"Teachers are sometimes blessed with the opportunity to celebrate the lives of their students. I certainly bask in the accomplishments of Anthony Cincotta, and LSU may well be proud of him," said Albert Meier. "He is an irresistible force that moved to fulfillment one of the most immovable objects – a new idea."

So next time you pick up a prescription, take a moment to consider all the paths that pill took to get into the palm of your hand … and remember that the next innovative treatment could be brewing in the laboratories of LSU at that same moment.

Want to learn more about commercialization and licensing opportunities at LSU? Visit www.lsu.edu/intellectual_property.



"One for the record books: LSU researchers discover the world's tiniest vertebrate"

by Kelly Hotard

Discovery. It's what fuels scientific knowledge, innovation and achievement, and ultimately, human progress.

But what drives discovery?

Ask most renowned researchers, and they'll likely tell you their greatest accomplishments have resulted from the combination of lifelong curiosity, tenacious passion for the subjects they study and support from those who recognize the significance of their work. Being in the right place at the right time doesn't hurt, either.

These factors certainly came into play for LSU biological sciences professor Chris Austin, who led a team of scientists, including LSU graduate student Eric Rittmeyer, on a three-month expedition to the island of New Guinea to study the region's high biodiversity ecosystems in 2009. While there, Austin's group unearthed something that broke a Guinness World Record and attracted the international spotlight.

New Guinea, the planet's largest island, is home to the world's tiniest frog species: *Paedophryne amauensis*, a variety of amphibians that scientists had never known existed.

The discovery was a product of both Austin's and Rittmeyer's previous research work on the island. For Austin, curator of herpetology at LSU's Museum of Natural Science, the trip was the latest in a series supported by the National Science Foundation to further his exploration of evolutionary genomics, biogeography, phylogenetics and conservation genetics.

In 2008, Rittmeyer had traveled to New Guinea with fellow Cornell undergraduates inspired by the field work of ornithologist Ed Scholes. One day, the team was sifting through fallen leaves searching for the source of a tiny, high-pitched noise. The culprit: a new diminutive frog species recently named *Paedophryne swiftorum*, which has an average length of 8.5 millimeters.

Rittmeyer returned to the island as a graduate student on Austin's research team. On the group's first night of collecting samples, they heard a noise that was both peculiar and familiar to Rittmeyer.

But the same "tink" that alerted the team to the creature's presence also made it difficult to locate. *P. amauensis*' mating call, while unique compared with other frogs, sounds very insect-like, similar to a cricket's chirp. Thus, before the group could be sure what was making the noise, they first had to locate where it was coming from.

Rittmeyer's experience with *P. swiftorum* helped the researchers quickly isolate the sound source to the leaf litter strewn across the tropical forest grounds. "Then, we grabbed a whole handful of leaf litter, put it into a plastic bag and very, very slowly went through it leaf-by-leaf until we saw that small frog hop off one of those leaves," said Austin.

Austin and his team knew they had discovered something significant, but they didn't immediately realize just how huge – or, rather, how small – their finding was. Austin is no stranger to discovering new species, having described numerous frogs, lizards and parasites previously unknown to science throughout his career. And New Guinea, which Austin calls a "hotspot of biodiversity," abounds with never-before-seen minuscule species.

But once back in Baton Rouge, Austin and Rittmeyer measured the specimen and learned the full extent of their discovery. At an average length of only 7.7 millimeters, or less than one-third of an inch, *P. amauensis* is not just the world's smallest frog species – it's also the smallest of all known vertebrates, or animals that have backbones.

In January 2012, the Public Library of Science's *PLoS ONE* journal published the group's research on the two frog species, establishing *P. amauensis* as the smallest known vertebrate and garnering hundreds of media mentions within the first hour – approximately 461 tweets and 129 online mentions – and hundreds more within days. That week, the frog also made its late-night national television debut, as comedians Jay Leno and David Letterman featured the now-ubiquitous photo of the creature perched atop a dime with ample room to spare.

Since then, the tiny frog has appeared and Austin's research has been noted in a wide variety of media, from prestigious news outlets like The Associated Press and BBC to prominent magazines like *National Geographic* and *Popular Science*.

But while the world's smallest vertebrate is a novel and monumental find in itself, the impact of the species' discovery extends much further than attracting media hype and piquing the public's interest.

"Everything new we discover in New Guinea adds another layer to our overall understanding of how biodiversity is generated and maintained," said Austin.

Kevin Carman, dean of LSU's College of Science, appreciates both the compelling magnitude of Austin's research for the field of science and the university, as well as its appeal to the general populace.

"It is exciting to discover the biggest or smallest of anything," said Carman. "It serves as a reminder of how much we still have to learn and how much fun science can be."

But Carman said Austin's discovery is also a fundamentally crucial addition to the body of scientific knowledge.

"Finding the world's smallest known vertebrate helps us understand the evolutionary limits of vertebrate structure and function, and that allows us to think about quite profound questions," said Carman. "For example, it is fascinating to contemplate the relationship of this tiny frog to a blue whale, the largest vertebrate that has ever lived."

Prior to the discovery of these two miniature frog species, which are terrestrial, extreme size in vertebrates seemed linked to aquatic creatures. An Indonesian fish formerly held the title of world's smallest vertebrate, while the blue whale, which has an average length of 25 meters, or 75 feet, still reigns supreme at the opposite end of the size spectrum. Thus,

Chris Austin conducts fieldwork in the wilds of New Guinea, where he recently discovered a diminutive frog species that also happens to hold the title of world's tiniest vertebrate.

Austin and his team, with the help of a local crew, set up their rudimentary campsite for the summer.

the scientific community thought perhaps buoyancy facilitated the development of extremism. However, Austin's discoveries challenge this idea.

Carman added that Austin's globally recognized achievement is also significant for reasons much closer to home.

"We're very proud of Chris' discovery, as it provides the latest in a long line of examples of how LSU researchers are at the very forefront of their disciplines," Carman said. "Chris is also a wonderful teacher and mentor. He made this discovery while working with his graduate student in an extremely remote part of the world. This illustrates how LSU students have extraordinary learning experiences while working with outstanding scholars."

Thomas Klei, LSU interim vice chancellor of Research & Economic Development, agrees.

"Dr. Austin's and his student's discovery certainly brought considerable attention to LSU," said Klei. "More importantly, however, it serves to demonstrate the importance of continuing to search our environment on all levels to expand our understanding of biodiversity and the ideas that emerge from these types of investigations and discoveries. I am sure Dr. Austin's laboratory will continue to add important new insights into our understanding of vertebrate ecology."

Austin looks forward to learning much more about these new species, their habitats and the role they play in the broader biological scheme of Earth. The discoveries of *P. amauensis* and *P. swiftorum* advance the Austin laboratory's mission of answering evolutionary questions, aiding in conservation efforts and describing species new to science.

"The ecosystems these extremely small frogs occupy are very similar, primarily inhabiting leaf litter on the floor of tropical rainforest environments," said Austin. "We now believe that these new species of diminutive frogs aren't biological oddities, but instead represent a previously undocumented ecological guild – they occupy a habitat niche that no other vertebrate does."

To watch Chris Austin talk about his tiny discovery and to hear *Paedophryne amauensis* in the wild, scan the QR code on your smart device.

LSU Museum of Natural Science

The vast storehouse of scientific information held within the collections at LSU's Museum of Natural Science, or LSUMNS, helps researchers understand the historical and contemporary processes that have shaped the world's biological diversity. With nearly three million specimens and growing, the LSUMNS collections are an invaluable resource that will yield countless important discoveries for generations to come.

Birds

With more than 169,000 specimens, LSUMNS' bird collection is the fourth-largest university-based collection in the world, behind Harvard, Berkeley and Michigan. The museum's holdings of birds from Peru, Bolivia, the West Indies and the southeastern United States are the largest in the world, and the collection is among the 10 largest in the world from Mexico, Guatemala, Belize, Honduras, Costa Rica, Panama and Argentina. The collection contains 140,000 skins, 22,000 complete skeletons, 8,000 fluid-preserved specimens, 12,000 stomach-content samples and thousands of tape-recordings of bird vocalizations.

Since 1978, more than 275 research publications, including 25 books, have been based either wholly or partially on bird specimens in LSUMNS. Several graduates of the LSU ornithology program have been presidents of leading North American scientific societies. Recent graduates of the LSU graduate program in ornithology are currently the research curators of some of the largest and most important bird collections in the world, housed at the Smithsonian, the Field Museum of Natural History in Chicago, the Natural History Museum at the University of Kansas, the Bell Museum of Natural History at the University of Minnesota and the Goeldi Museum in Brazil. LSU ornithologists are the world's experts on birds from several Latin American regions, including Peru and Bolivia, which together contain more species of birds than any other similar-sized region in the world. LSU features the only university museum in the world that has conducted ornithological field research in South America every year since 1962.

Fish

The permanent collection of fishes includes more than 300,000 specimens, with representatives of all major groups of living fishes in the world. The holdings are mainly from the northern Gulf of Mexico, but there are also important collections from the Hawaiian Islands, Mexico, Central and South America, Vietnam, Taiwan, Australia and several island groups in the western Pacific Ocean.

Herpetology

The collection of reptiles and amphibians is comprised of more than 81,000 specimens. This collection is extremely rich in snake species, with 359 genera and 880 species represented. The remaining herpetology groups are represented as follows: 165 genera and 581 species of lizards; one genus and one species of tuataras; 49 genera and 90 species of turtles; eight genera and 13 species of crocodilians; 104 genera and 496 species of frogs; 38 genera and 151 species of salamanders; and 12 genera and 19 species of caecilians. The collection contains 27 holotypes, or specimens representing species new to science, which is a disproportionately large number for a collection of this size. The herpetology collection is worldwide in scope. The snake skeletal collection is among the largest and most diverse in the world. The collection of amphibians and reptiles from the Mexican state of San Luis Potosí is the largest in the world, and the collections from Honduras and Peru are among the top five in the world. Approximately 55-60 percent of the currently recognized genera of snakes are represented in the collection.

Museum Engagement

The LSUMNS has a small exhibit area for visitors and provides limited services to school groups that visit. The priority of the museum's education program, and what makes it unique, is that it is tailored to disseminate ongoing research performed by LSUMNS curators and graduate students, as well as the research conducted by faculty in the departments of Biological Sciences, Geology & Geophysics, and Geography & Anthropology. In turn, this program helps faculty meet the broader impact requirements of granting agencies. The museum also provides educational behind-the-scenes tours for LSU undergraduate students, high school students, teachers, politicians and conservation organizations. In addition, the museum faculty frequently engage high school students in field and laboratory research and mentor high school student theses and science fair projects.

— Zac Lemoine

Exploding Stars –
From Subatomic Physics to the Physics of the Universe

by Ashley Berthelot

We are made of stardust. Nearly all of the elements of the periodic table are manufactured by nuclear processes inside stars, many of them in the spectacular explosions called supernovae that occur when massive stars exhaust their nuclear fuel and die.

These supernova explosions expel their newly created elements into interstellar space, where future generations of stars, planets – and perhaps life – can be born. Researchers in LSU's Department of Physics & Astronomy are studying these dramatic events taking place in the cold expanse of space, from the synthesis of elements in the interiors of stars to the supernova explosions and the debris clouds left behind.

"When a star explodes, it ejects matter into the universe that eventually trickles down to Earth," said Michael Cherry, chair of LSU's Department of Physics & Astronomy. "When we study astronomy and astrophysics, we are studying the very genesis of our existence. We are made of stardust."

Nuclear Astrophysics – Where does the Periodic Table Come From?

Nuclear astrophysics is the study of how atoms heavier than hydrogen and helium are synthesized inside stars. LSU experimenters Jeff Blackmon and Catherine Deibel study atomic nuclei and nuclear reactions in the laboratory that are important in astrophysical objects, particularly in explosive stellar events such as novae, X-ray bursts and supernovae. Novae are recurring explosions that take place in binary star systems when matter from a companion star falls onto the surface of a white dwarf and burns explosively in a thermonuclear runaway, ejecting material at high speeds into space. Supernovae are more violent explosions, which destroy the original star, occurring when massive starts nearing the ends of their lives undergo a violent core collapse or when the mass of an accreting white dwarf star gets too large. The nuclear reactions occurring in these events are believed to have formed most of the elements found in our galaxy.

In these thermonuclear explosions, short-lived radioactive atoms are created through nuclear reactions where protons, neutrons, and alpha particles fuse with existing atomic nuclei. These reactions are studied at accelerators using particle beams incident on targets of stable nuclei. Currently, the field is advancing rapidly with the advent of radioactive ion beams, which for the first time allow us to study reactions with radioactive atoms that are important in stellar explosions.

Professors Blackmon and Deibel and their students perform measurements at Oak Ridge National Laboratory, or ORNL; at Argonne National Laboratory; at the National Superconducting Cyclotron Laboratory, NSCL, at Michigan State University; and at TRIUMF in Vancouver. In one recent study at ORNL, beams of short-lived tin nuclei were used to perform a fundamental test of the nuclear shell model and improve our understanding of how heavy nuclei are synthesized by neutron bombardment during supernova explosions. The results were published in *Nature* and featured on the cover of the August 2010 *Physics Today*.

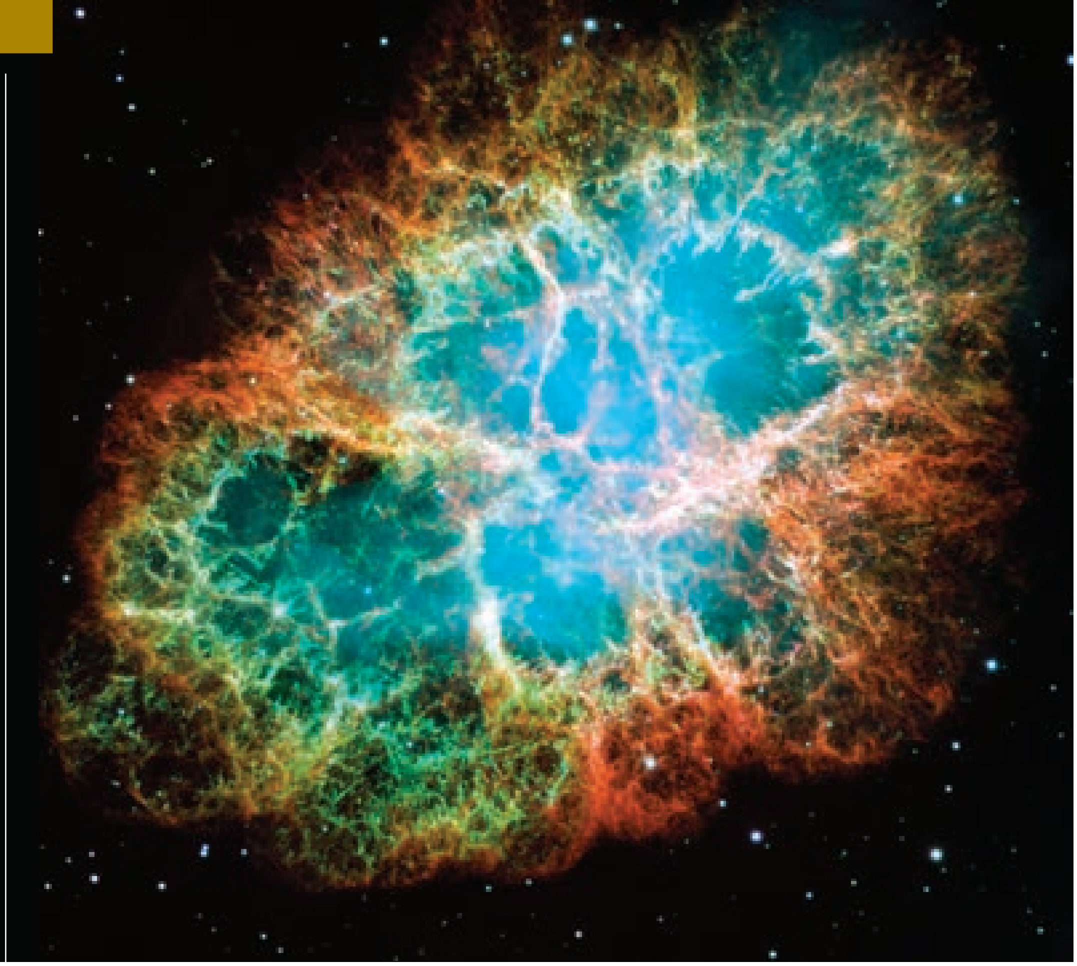
The group has collaborated with colleagues at Florida State University to construct the array for Nuclear Astrophysics Studies with Exotic Nuclei (ANASEN). ANASEN combines three different types of detectors together with state-of-the-art electronics into a powerful instrument for studying reactions induced by low intensity beams of radioactive ions. Students at LSU and FSU are now using ANASEN at Florida State's linear accelerator facility to directly measure nuclear reaction cross sections important in X-ray burst explosions. ANASEN will be moved to the NSCL for experiments next year. The development of ANASEN allows LSU students to gain invaluable hands-on experience in forefront instrumentation and techniques that are important for various fields from health care to national security. Two LSU undergraduates, Laura Mondello and Hannah Gardiner, traveled to present results of their research with ANASEN at American Physical Society Conferences in Santa Fe, NM and East Lansing, MI earlier this year.

What Stars Become Supernovae?

Stars shine because of nuclear fusion. In the cores of ordinary stars like the sun, temperatures are high enough to allow hydrogen nuclei to fuse to form helium and release energy. In heavier stars, nuclei can be produced by fusion (nucleosynthesis) all the way up to iron. The elements heavier than iron, though, cannot be formed in normal stars. These are produced during explosive events – for example supernova explosions that occur after normal nuclear fusion ends. In thermonuclear, or Type Ia, supernovae, the light from the explosion can outshine an entire galaxy. An LSU team consisting of Bradley Schaefer and Ph.D. student Ashley Pagnotta has now proved that these supernovae are caused by pairs of white dwarf stars, stars that have exhausted their nuclear fuel and are slowly cooling down at the ends of their lifetimes. Their solution to a 40-year old problem was recently published in *Nature*.

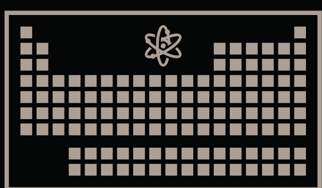
The possible precursor system types, called progenitors, were considered to be either a pair of white dwarfs in a close binary orbit that spiral into each other due to gravitational attraction (the double-degenerate model) or another type of binary where an ordinary star in orbit around a companion white dwarf is feeding material onto the white dwarf until it reaches a critical mass (the single-degenerate model).

The progenitor problem has been considered to be such an important issue that the National Academy of Sciences, in its latest 10-year review of the state of astronomy and astrophysics, placed the question among the top



This view of the Crab Nebula in visible light comes from the Hubble Space Telescope and spans 12 light-years. The supernova remnant, located 6,500 light-years away in the constellation Taurus, is among the best-studied objects in the sky.

Image: NASA/ESA/ASU/J. Hester



The nuclear reactions occurring in novae and supernovae events are believed to have formed most of the elements found in our galaxy.

Periodic Chart: Jakob Vogel/The Noun Project

nine questions currently facing astronomy. Schaefer and Pagnotta used new images from the Hubble Space Telescope of a supernova remnant named SNR 0509-67.5 to demonstrate that there was no surviving companion star. This made it possible to rule out all possible classes of progenitors except for the close pair of white dwarfs.

"One possible way to distinguish between the various progenitor models is to look deep into the center of an old supernova remnant to find, or not find, the ex-companion star," said Schaefer. "The logic here is the same as expressed by Sherlock Holmes in 'The Sign of the Four,' that 'when you have eliminated the impossible, whatever remains, however improbable, must be the truth.' For SNR 0509-67.5, all but one model has been eliminated as impossible, so the one model remaining must be the truth."

The LSU team found the central region of SNR 0509-67.5 to be starless to a very deep limit (visual magnitude 26.9). The faintest possible ex-companion star for all models except the double degenerate is a factor of 50 times brighter than the observed limit, so that all explanations except for the pair of white dwarf stars could be rejected.

"The issue of determining the origin of thermonuclear supernovae has been a fundamental problem in the field of astronomy," said Schaefer. "Many possible explanations have previously been suggested, and all but one of these requires that a companion star near to the exploding white dwarf be left behind after the explosion."

"The most interesting part of this project was getting an unexpected answer at the end," said Pagnotta. "Based on previous results, we anticipated finding a non-white dwarf star in the center of the supernova remnant, but the deep Hubble Space Telescope images showed no stars there (a result which has since been confirmed by other groups), and so we were able to conclude that the only possible star system that could have caused this particular supernova consisted of two white dwarfs that spiraled together and then exploded. It's always very exciting when your observations show new and unexpected phenomena." Pagnotta was recently awarded the Charles E. Coates Outstanding Dissertation Award for her thesis work on stellar explosions, and is currently a Postdoctoral Researcher at the American Museum of Natural History in New York.

A Nobel Accomplishment

Because supernova explosions are so bright and can be seen from enormous distances across the universe, they have been used to gauge the size of the universe. Schaefer has been involved in this work as well: In the 1990's, two teams of astronomers attempted to measure the expansion of the universe by using the distances and brightness of far-away supernovae. They restricted themselves to Type I supernovae because they knew the intrinsic brightness of these events. The surprising result was that the two teams independently found that the universe was expanding faster than expected. This accelerated expansion of the universe is due to "dark energy" embedded in the fabric of space. We still do not know exactly what dark energy is, but we do know that it makes up approximately 70 percent of the mass-energy of the universe.

Last year's Nobel Prize was awarded for the discovery of the accelerated expansion and dark energy. Schaefer, as a member of one of the international teams that made the discovery, attended the Nobel ceremony in Stockholm in December.

"What we saw was that the expansion of the universe is accelerating as if something is 'pushing' it," said Schaefer. "This new understanding not only sheds light on our current situation, but also offers some scientific predictions of how the Earth will end. One consequence of this acceleration is that the universe will continue expanding forever, becoming colder and emptier as time goes on."

"We are extremely excited about Brad's contribution to the Nobel Prize-winning research in physics," said Kevin Carman, Dean of LSU's College of Science. "This is a wonderful and richly deserved recognition; it also reflects well on the quality of our faculty and students and epitomizes the quality of research in the College of Science."

Dusting Off the Big Bang

Another "supernova superstar" at LSU is Geoff Clayton, who was part of a team that studied Supernova 1987A, perhaps the most extensively studied and well-known stellar explosion we have observed. SN 1987A is located relatively nearby in the Large Magellanic Cloud, a satellite galaxy to the Milky Way. Because it is located so close, when its light reached Earth in February 1987, it was observed by the naked eye.

Clayton and his team discovered "cold" dust around a supernova for the first time, suggesting that supernovae in general might the source for the large clouds of debris seen in other galaxies shortly after the Big Bang. In space, cold is really cold. The dust around SN 1987A is about -400 degrees Fahrenheit.

"Supernova 1987A is the closest supernova to occur in almost 400 years, so it is particularly exciting that our results focus on its surroundings," said Clayton. "It's also exciting to see this colder dust. We've been able to detect warmer particles before, but the new instruments on the Herschel Space Observatory allow us to view dust that was invisible to other telescopes because it was too cold."

Astronomically speaking, "dust" refers to solid clumps of elements like grains of sand, which include most atoms found in space (excluding hydrogen and helium). These space particles are important because they contain the elements from which the Earth and the life on it were

NEUTRINO OSCILLATIONS

LSU physicists were recognized as part of the Physics World Top 10 Physics Breakthroughs of 2011 for their studies recording the first real indication of a new type of neutrino oscillation.

LSU Department of Physics & Astronomy professors Thomas Kutter and Martin Tzanov and professor emeritus William Metcalf, along with graduate and undergraduate students, have been working for several years on an experiment in Japan called T2K, or Tokai to Kamioka, Long Baseline Neutrino Oscillation Experiment, which studies the most elusive of fundamental subatomic particles – the neutrino. In the spring of 2011, they announced an indication of a new type of neutrino transformation or oscillation from a muon neutrino to an electron neutrino.

"Our recent T2K results cracked open a door to what promises to be a very rich and exciting field for future neutrino studies and a better understanding of nature at the smallest scales," said Kutter. "In particular, the measurement of differences in the behavior of neutrinos and their anti-matter partners, anti-neutrinos, seems to have become within reach of the next generation of experiments which are currently being planned."

In the T2K experiment in Japan, a beam of muon neutrinos – one of the three types of neutrinos, which also include the electron and tau – was produced in the Japan Proton Accelerator Research Complex, or J-PARC, located in Tokai village, Ibaraki prefecture, on the east coast of Japan. The beam was aimed at the gigantic Super-Kamiokande underground detector in Kamioka, near the west coast of Japan, 295 kilometers, or 185 miles, away from Tokai. An analysis of the detected neutrino-induced events in the Super-Kamiokande detector indicated that a small number of muon neutrinos traveling from Tokai to Kamioka transformed themselves into electron neutrinos.

"It took the international collaboration about ten years to realize the project and bring it from first idea to first results," said Kutter, leader of the T2K project at LSU. "The entire LSU team is honored to be part of the collaboration and proud to contribute to the experiment. We expect many more results in the near future and look forward to the new research opportunities which are likely to arise from the tantalizing indication of this new neutrino oscillation."

This is significant because neutrinos were first predicted theoretically in 1930, first actually detected in 1956, and for 50 years were assumed to have zero mass. But neutrino oscillations require mass.

With mysterious linkage between the three types, neutrinos challenge the understanding of the fundamental forces and basic constituents of matter. They may be related to the mystery of why there is more matter than anti-matter in the universe, and they are the focus of intense study worldwide.

formed – one cannot fully understand the abundance of these elements without first studying dust.

"In our galaxy, stars producing much of the dust are billions of years old, but stars of that age don't exist yet in these very young galaxies," said Clayton. "It has been suggested that objects like Supernova 1987A might be responsible for these dust clouds, and now, thanks to our advanced new technologies, we are able to start the process of proving whether this is true."

The Not-So-Standard Standard

The Crab Nebula is the wreckage of a star in our own Galaxy. The light from the supernova was seen by Chinese astronomers who recorded the presence of a "guest star" in the constellation Taurus in 1054 AD. The debris cloud now is a source of high energy X-rays and gamma rays, optical light, and radio emission. Because it is relatively nearby and bright, it has been studied extensively. And because its high energy emission has been observed to be extraordinarily steady, it has been used as a "standard candle" – a source so steady and consistent that astronomers used it to calibrate their instruments.

"Nearly every other source of high energy radiation in the sky shows evidence of explosive, time-variable, transient activity. The Crab was the exception," said Cherry. "It was the only object that was bright enough and constant enough to serve as a standard candle."

But LSU physicists Cherry, Gary Case and graduate student James Rodi, together with an international team of colleagues using the Gamma-ray Burst Monitor, or GBM, on NASA's Fermi gamma-ray space telescope, recently discovered that the Crab Nebula isn't so constant at all – in fact, it is dimming.

The discovery occurred while the LSU researchers were working on a catalog of high energy X-ray and gamma ray sources. As they were preparing the catalog, which was later published in the *Astrophysical Journal*, they realized the intensity from the Crab was dimming by a few percent a year.

"We were using the Crab as our calibration source and comparing the other high energy sources to it," said Case. "But as we collected more data, we noticed that the intensity we were measuring for the Crab was going down. This was a rather startling discovery, and it took a while for us to believe it."

"Every astronomer learned at their mother's knee that the Crab was constant," said Cherry. Because the constancy of the Crab was so firmly believed by astrophysicists, the LSU team initially assumed they were seeing an instrumental effect. To better understand their data, they gathered data from three other X-ray/gamma ray observatories currently in orbit – NASA's Swift and Rossi X-Ray Timing Explorer and the European Space Agency's International Gamma-Ray Astrophysics Laboratory.

The result? When they looked at the raw data, before instrumental corrections were applied, they found that all four instruments showed the same decrease in intensity, proving that the changes weren't due to a specific instrument, but rather the Crab itself.

The cause of the changes is not understood, but apparently involves changes in either the acceleration of high energy electrons or the strength of the magnetic fields close to the nebula's central neutron star. In fact, looking back at older data showed that the Crab apparently varies in intensity by a few percent on a time scale of three or four years. The GBM team and others are now monitoring the Crab to understand its variations as a clue to the Crab's detailed behavior.

Exploding Star Research and Physics & Astronomy

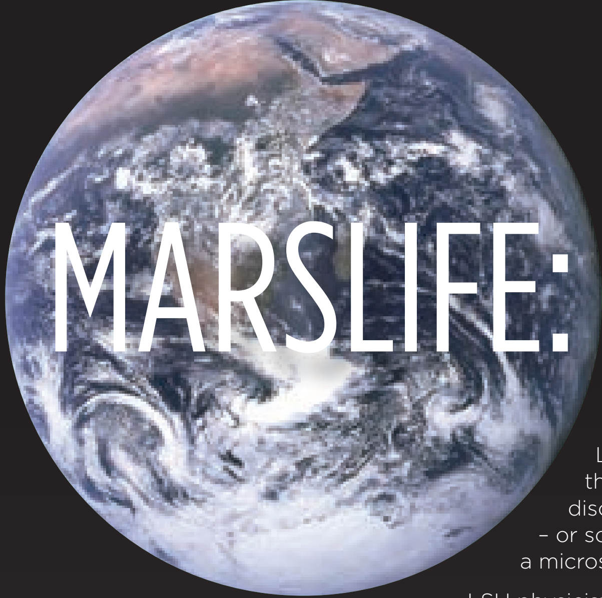
The LSU research into exploding stars – the mechanisms that create them, the remnants that are left behind, and their connection to the properties of the universe – connects physics on the smallest scales we can study to physics on the largest scales we can imagine.

The environments inside stars, during stellar explosions, and around the remnants of the explosions – white dwarfs, neutron stars, black holes, and the nebulae surrounding them – provide probably the most extreme and exotic laboratories that physicists and astronomers can study anywhere in the universe.

Also, there are interesting spin-offs to deep-space research. For example, the study of gamma rays has direct implications for national security and cancer therapy. Energetic particles that cause "space weather" have an impact on weather conditions on Earth. And radiation detector development has applications from nuclear power to oil well logging to health physics.

With approximately 50 faculty members and their students pulling in roughly $8 million in federal grants each year, Physics & Astronomy has an extensive portfolio of research, from work with practical applications to fundamental physics. "What our astrophysicists are studying are the processes that occur in the most extreme laboratories the Universe has to offer," Cherry said. "How energy is transferred from stars is directly relevant to where we came from. We're trying to understand the physics behind it all."

Check out the Ask 5 With Ashley Pagnotta, scan the QR code on your smart device.



MARSLIFE: Scientific Balloons Lead the Charge Toward Identifying Microscopic Life Outside of Earth

Little green men. Silver space suits. Flying saucers. These are the images that often come to mind when the term "alien life" is discussed. But in reality, scientists are looking for nothing so grand – or so cliché. In fact, the search for life on other planets has begun on a microscopic level … and the search begins right here at home.

LSU physicists and biologists, along with more than 20 undergraduate and graduate students, plus collaborators from Southern University, Louisiana Tech, NASA-Ames and Aarhus University in Denmark, have taken on a project studying earthly microorganisms that tolerate conditions similar to those found in extra-terrestrial environments. It's called MARSLIFE, or Modes of Adaptation, Resistance and Survival for Life Inhabiting a Freeze-dried-radiation-bathed Environment, and it offers a chance to open doors for understanding the extraterrestrial.

"Determining the limits of the biosphere here on Earth is the important first step for studying life on other planets," said Professor of Physics & Astronomy John Wefel, "and MARSLIFE is taking that step."

Some goals of MARSLIFE include investigating existing and novel microorganisms with tolerances to cold, desiccation and radiation as models for astrobiology; using laboratory simulators to assess responses of selected extremophiles to temperature, pressure and radiation conditions that exist in a range of extraterrestrial environments; characterizing biological resistance mechanisms to freezing, desiccation and radiation; and improving technologies for the detection and sampling of microorganisms under conditions similar to the surface of Mars.

Sponsored by NASA EPSCoR and the Louisiana Board of Regents, the team, led by Wefel, biologist Brent Christner and physicist Gregory Guzik, uses a scientific balloon, which starts off as a relatively large, helium-filled inflatable, but, once relieved of the pressures of Earth's atmosphere, the largest one expands to become larger than LSU's Tiger Stadium. These balloons carry experimental payloads to sample the microbes found at various heights, and return samples to the biology labs to test the microbe's "hardiness."

"Scientists have used ballooning technology for more than 200 years to investigate the secrets of the universe," said Guzik. "Modern scientific balloons allow instruments weighing thousands of pounds to be placed above 99 percent of the Earth's atmosphere for extended periods of time at a fraction of the cost to put a satellite in orbit. For MARSLIFE we are using this technology to investigate the limits of our biosphere as a function of altitude."

Originally, members of the group worked on very different projects in the same place – Antarctica. Christner studied microbes that live in subglacial lakes on the frozen continent, while Wefel and Guzik ran scientific ballooning experimental missions there. Now, as a team, the group can test their theories much closer to home, while continuing to offer area students a unique, research-intensive experience.

"The strongly interdisciplinary and technical nature of this project provides a unique training opportunity for our students, allowing them to broaden their scientific horizons beyond the typical experiences gained during an undergraduate or graduate education," said Christner.

"MARSLIFE is producing technologically-informed, interdisciplinary students and will have long-term benefits in nurturing the next generation of scientists in Louisiana."

Other LSU participants include John Battista, Gary King, Dana Browne, Jim Giammanco, Michael Stewart, Doug Granger and Brad Ellison. Participants from area universities include Sumeet Dua and Pradeep Chowriappa of Louisiana Tech and Larry Henry from Southern University, and external advisors include Kai Finster from Aarhus University and Rocco Mancinelli and Chris McKay from NASA Ames.

— Ashley Berthelot

New Drugs

by Paige Brown

At LSU, the development of new medical drugs takes on many different shapes and forms, from the determination of new drug molecular structures that fit into human disease targets like a key in a lock, to high-throughput screening of natural plant product libraries for unknown drug properties. At the base of drug development is laboratory discovery, advanced measurements on state-of-the-art equipment and, most importantly, teamwork.

Structure is Everything

It all started in 1953, when James D. Watson, Francis Crick and Rosalind Franklin deciphered the double-helical structure of our hereditary material from a ring-like pattern on a picture of DNA taken with X-ray diffraction equipment like that found in LSU's Center for Advanced Microstructures & Devices, or CAMD. The discovery of the structure of a complex three-dimensional structure such as DNA was a breakthrough for modern medicine, and opened up a whole new field of structural biology.

Marcia Newcomer, professor in the Division of Biochemistry & Molecular Biology within the Department of Biological Sciences at LSU, is now putting X-ray crystallography and other structural biology techniques to work for the development of new drugs for inflammatory diseases. Newcomer is using synchrotron radiation resources found at CAMD to decipher the shapes of molecules important for new drug development.

Using information about the shape of a drug target molecule can help researchers like Newcomer fashion drug compounds that stick to these drug targets and stop their disease-causing activities in the human body.

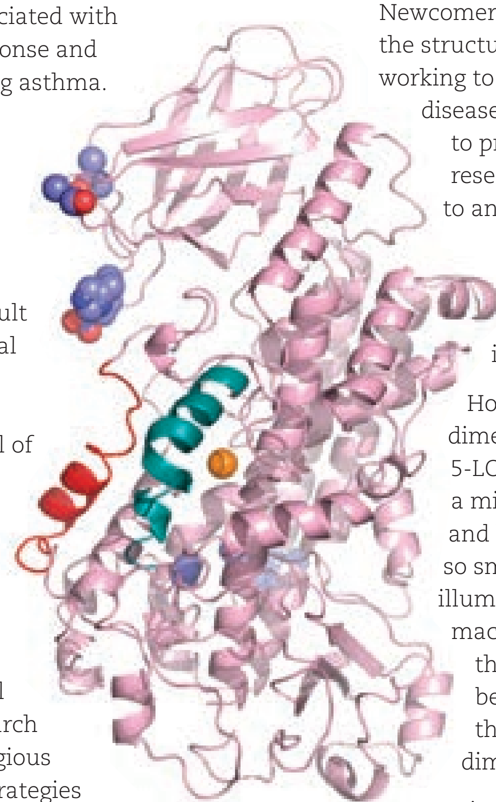
"One of the ideas behind drug design is that if you know what the molecules look like that you want to stop, you can make something that is specifically designed to jam them up, to stop them from working," Newcomer said. "This is an important approach to drug design. Basically, you get a three-dimensional structure of a molecule and then you make something small, like a silver bullet, to take this molecule out. But you have to find a molecular structure that is a good drug target."

Newcomer works on an enzyme called 5-lipogenase, or 5-LOX, which initiates the synthesis of compounds called leukotrienes in the human body. Leukotrienes promote inflammation and inflammatory responses, for example, swelling and contractions of airway muscles in asthma patients.

"That is part of the normal inflammatory response to help you get rid of microbes and other dangerous foreign bodies," Newcomer said. "But you also need to shut it down in some cases before it causes problems."

There are several problems associated with a heightened inflammatory response and leukotriene production, including asthma. Newcomer's enzyme of interest, 5-LOX, is crucial in the pathway that produces leukotrienes in the human body, and thus is a prime target for drug inhibitors. Unfortunately, 5-LOX is also an unstable enzyme and very difficult to work with. The pharmaceutical company MERCK had tried for many years to determine this enzyme's structure with the goal of fashioning new drugs to hinder inflammation based on its shape, but finally gave up the pursuit.

Then, in 2011, Newcomer and colleagues were the first to successfully decipher the crystal structure of the enzyme in research that was published in the prestigious *Science* journal. Using creative strategies to stabilize the fickle 5-LOX, Newcomer's group was able to create high-quality crystals of the active enzyme. Using these crystals, the group could get clear pictures of the enzyme's three-dimensional shape using X-ray crystallography.



Protein Structure of 5-LOX. Marcia Newcomer.

According to scientists who have since written reviews of Newcomer and colleagues' groundbreaking work, the new structural information opens doors for discovery and development of new therapeutics for inflammatory diseases and ailments such as asthma, cardiovascular disease and even cancer.

One of the first drugs developed to treat the AIDS virus was developed in this way.

"Scientists got a structure of one of the molecules that is necessary for the AIDS virus to replicate, and then they made something that would bind this molecule and stop it from accomplishing what it's supposed to do in the lifecycle of the virus," Newcomer said.

Molecular structure is of vast importance when it comes to how drugs work against disease targets in the human body. For example, the antibiotic penicillin works because its shape allows it to bind to the bacterial enzyme that helps a bacterium make its own cell wall.

"If the bacterium can't make its own cell wall anymore, then it can't survive, thus the antibacterial properties of penicillin," Newcomer said.

Newcomer and her colleagues at LSU work on the structural biology end of drug development, working to determine the structures of target disease molecules like 5-LOX in order to provide this information to other researchers who can make drugs that bind to and inhibit the action of these molecules.

"We make it possible for other people, including pharmaceutical chemists, to use this structure to develop drug inhibitors," Newcomer said.

However, determining the three-dimensional structure of a molecule like 5-LOX is not as simple as looking through a microscope. The molecules Newcomer and her colleagues study are very small – so small that the light rays that normally illuminate the objects we can see in our macro world can't be used to visualize them. The structure of molecules must be determined using analysis equipment that uses X-rays to determine three-dimensional shape.

Having LSU's CAMD facilities nearby has been a major asset to Newcomer's research. The synchrotron particle accelerator at CAMD can produce many different types of X-rays required for three-dimensional crystallography. While researchers can produce the radiation needed for molecular structure analysis in home laboratory sources, the rays generated from these sources are not very bright, and they only consist of one color, or wavelength, of light. A synchrotron produces white radiation, which is a combination of different wavelengths of X-rays.

"If you think about light being a spectrum of colors, home lab X-ray sources give you only one color," Newcomer said. "But there are experiments for which you need

LSU Professor Marcia Newcomer uses X-ray crystallography to decipher the shape of molecules important to drug development.

more than one color. For these, you need to go to a synchrotron source. You can't get three-dimensional structure information without it."

"CAMD is one of only six facilities in the United States that you can do this kind of work at," Newcomer said. "While our group still gets some data from the brightest synchrotron near Chicago [Advanced Photon Source at Argonne National Laboratory], we still use CAMD for all of our preliminary work. This makes our work go so much faster, because if we had to organize around when we can get time in Chicago, it would take years to do what we can do now in much shorter time."

Newcomer has always worked on molecular structures. One of the reasons she went into the structural biology field was the promise that someday it could be helpful in drug design. Now, with the crystal structure of 5-LOX determined by Newcomer's group, structural biologists and medicinal chemists can team up to design new enzyme inhibitor therapeutics.

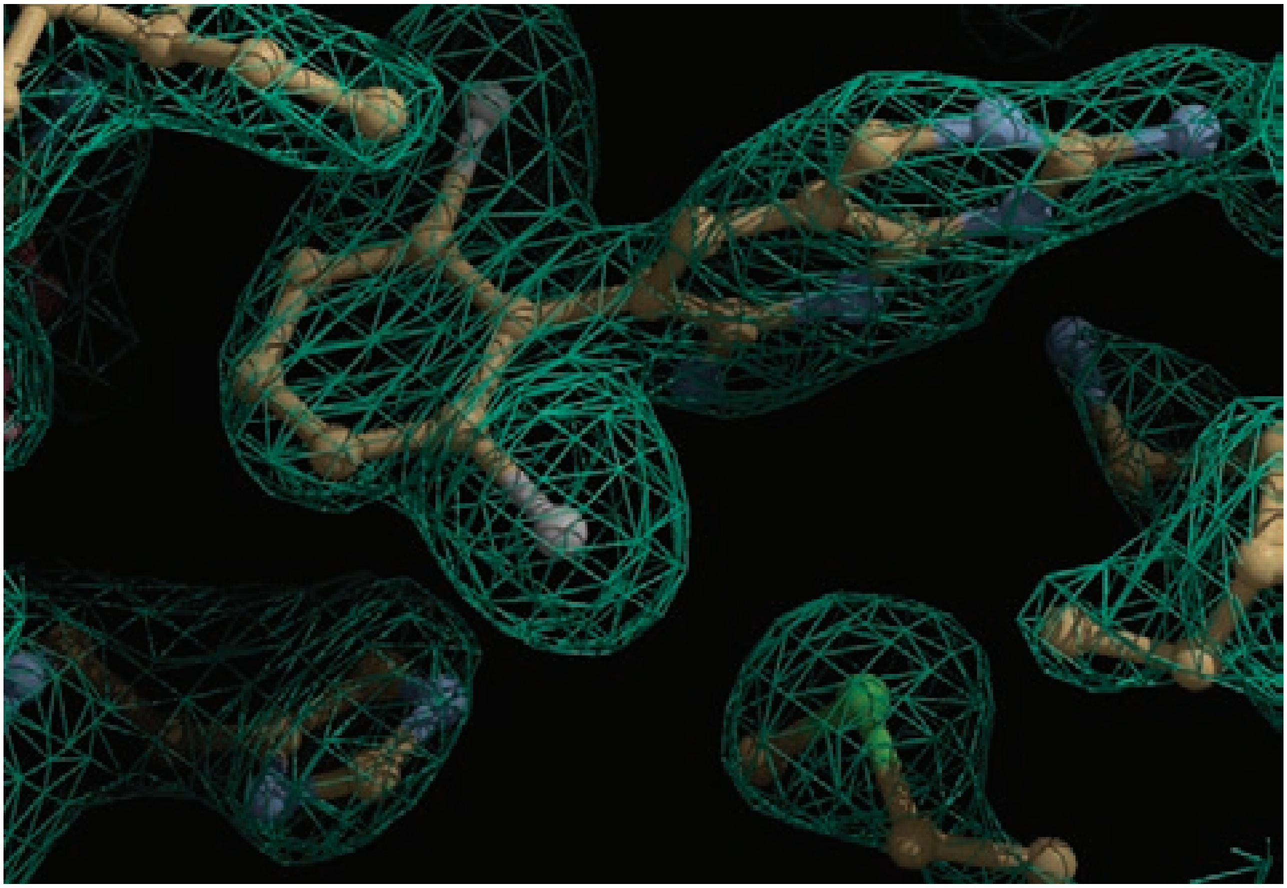
Just as 5-LOX catalyzes the synthesis of inflammatory molecules in the human body, Newcomer's research, along with her use of unique resources available at LSU, has served as a catalyst for new efforts to produce drugs for severe inflammatory diseases.

A Team Approach

Today, Grover Waldrop, adjunct professor in the LSU Department of Chemistry and professor in the Department of Biological Sciences, has assembled a team of LSU researchers spanning the fields of chemistry, microbiology and computational studies to fight a particularly nasty problem: antibiotic-resistant bacteria.

In 1995, Waldrop began work on acetyl CoA carboxylase, or ACCase, an enzyme involved in metabolism of fatty acids in animals, plants and bacteria. ACCase is a target for drugs to help fight obesity and for drugs that kill bacteria, or antibiotics, where bacteria will not grow if deprived of this enzyme. In 2004, Waldrop's groundbreaking work with the bacterial form of ACCase, which is involved in the making of bacterial cell membranes, akin to the "skin" protecting bacteria from their outside environment, earned him an antibiotic development partnership with Pfizer, the world's largest research-based pharmaceutical company.

"I learned a lot about pharmaceutical development, of which I knew nothing," Waldrop said. "We developed some molecules that targeted my enzyme and had antibacterial activity."



Pfizer inhibitor bound to Waldrop's ACCase enzyme.

Unfortunately, in 2008, Pfizer discontinued their entire antibiotic drug development division.

"The reason they dropped all of their antibiotic projects is because antibiotics are not profitable," Waldrop said. "Yet there is a looming public health care crisis because of the dramatic rise in antibiotic resistant bacteria. This is one example where a market-driven approach does not reach the best solution."

Meanwhile, Waldrop's colleagues at Pfizer encouraged him to continue his research path.

"They felt that there was a clear medical need for this type of work," Waldrop said. "So they sent me all of their chemicals and materials. In a single day, we received seven large boxes. It was like Christmas!"

The end of Waldrop's collaboration with Pfizer catalyzed a new direction in his work, one that harnesses a more multi-disciplinary and team-based academic approach. While industry is limited by economic responsibilities, Waldrop believes there is a niche for an academic approach to antibiotic development.

"One laboratory can't develop a drug," Waldrop said. "Everybody needs to work together to achieve a single goal. Where you involve multiple people, you have more chance of success."

Waldrop and his collaborators Carol Taylor, associate professor in the LSU Department of Chemistry; Greg Pettis, associate professor in the LSU Department of Biological Sciences; and Michal Brylinksi, joint assistant professor in the LSU Department of Biological Sciences and the Center for Computation & Technology, or CCT, are now pursuing what Waldrop calls a two-pronged approach to antibiotic development. This approach involves searching for both synthetic and natural products that can target his enzyme and have antibiotic properties.

In collaboration with Taylor's organic synthesis laboratory, Waldrop's group is constructing a synthetic prototype for a new antibiotic. The collaborative project analyzes the properties of known ACCase inhibitors that have been transformed in an effort to improve their ability to bind to the bacterial enzyme (ACCase).

Waldrop also collaborates with Brylinski, who works on the virtual side to discover new drug targets via computer modeling. Modern drug discovery is strongly supported by computational techniques, which can help identify new potential drug compounds. Brylinksi's group

A sampling of LSU's drug development talent (from left to right): Associate Professor of Chemistry Doug Gilman, Associate Professor of Biological Sciences Greg Pettis, Professor of Biological Sciences Grover Waldrop and Assistant Professor of Biological Sciences Michal Brylinski.

can screen through large libraries of virtual compounds to determine promising inhibitors of Waldrop's bacterial enzyme. The calculations, which require substantial computing power, will be carried out on a new LSU high-performance computer cluster provided by High Performance Computing at LSU, or HPC@LSU, a partnership between LSU's Information Technology Services and CCT.

"The goal is to use computational modeling to limit the size of the screening library to those compounds that most likely exhibit the desired biological activity," Brylinski said. "In this project, we will evaluate millions of compounds in silico [i.e. via computer simulation] prior to experimental screens, at a fraction of the cost."

Armed with computational screening and organic synthesis resources, Waldrop's lab is building up compounds that prevent bacteria from making their own cell walls. By determining the three-dimensional shape of ACCase and potential inhibitor targets via X-ray crystallography at LSU's CAMD facilities, Waldrop and his colleagues can build, from the ground up, inhibitor drugs that fit lock-in-key inside the active site of the enzyme.

However, Waldrop isn't stopping with synthetic products. He is also going down the unbeaten path of natural product screening for antibiotic development.

The cranberry, *Vaccinium macrocarpon*, has an extract that has proven effective in inhibiting enzymes.

"I learned that Pfizer didn't screen for natural products," Waldrop said. "So now, our lab does natural product screening. Many botanical products may be active as antibacterials."

In collaboration with the Botanical Research Center at Pennington Biomedical Research Center, Waldrop's group recently screened his ACCase against a collection of natural products and found an unusual target: cranberries.

"Cranberry extract inhibited my enzyme," Waldrop said. "Cranberries – who would have known?"

According to Waldrop, the LSU Herbarium, a facility that houses more than 180,000 plant specimens, could be a gold mine for antibiotic screening.

"There is a lot of potential there," Waldrop said. "We are looking for molecules that can be used as drugs against bacteria. This is truly applied research."

Finally, all new antibiotic prototypes developed by Waldrop's team, whether synthetic or natural, can be examined for antibiotic activity against known bacterial pathogens in Pettis' microbiology laboratory.

"We could never do this work without our organic chemistry resources in Taylor's lab and Pettis' measurements of microbial activity," Waldrop said. "It's not just my lab. My work benefits from the diverse resources available at LSU, including synchrotron radiation available at CAMD, thousands of specimens at the LSU herbarium and computational screening abilities."

One of the project's most invaluable resources, however, is teamwork.

"Had Pfizer not called me, and had I never collaborated with them, I would never have realized the importance of teamwork," Waldrop said. "I learned that a team approach is the only way that you are going to succeed, with everyone working together on a single goal. I'm trying to do that here at LSU."

Waldrop is trying to foster teamwork at LSU, encouraging his colleagues to increasingly take this approach.

"It's the same concept as taking a sports team mentality," Waldrop said. "A person who is not a team player can spoil a whole game. Everybody is playing their role here, and we are slowly making progress."

According to Waldrop, drug development research at LSU is like training for the big game. You have many more failures than you do successes, but in the end, teamwork is everything.

High Performance Computing at LSU

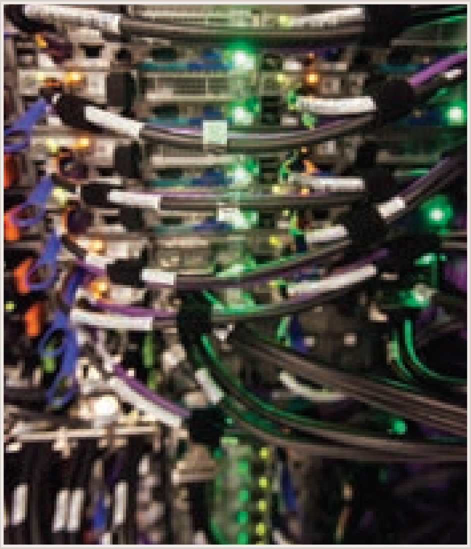
How much oil gushed into the Gulf of Mexico after the BP Deepwater Horizon rig explosion? Can genome sequencing predict disease development? What happens when two black holes collide in space? These are just a few of the many science and engineering questions LSU researchers and students answer with the help of SuperMike-II, the university's new supercomputer, which arrived at LSU's Fred C. Frey Computing Services Center in July 2012.

Researchers use supercomputers for complex, large-scale numerical projects and simulations. These machines employ a large number of computational cores, which connect through a high-speed network to run multiple calculations at once or collaborate on a single problem.

SuperMike-II, a $2.6 million system built by Dell, features 440 nodes, each with 16 Intel cores for a total of 7,040 computational cores. It runs 10 times faster than its immediate predecessor at LSU, Tezpur, and 100 times faster than LSU's original SuperMike. This new supercomputer's size and speed allow a greater number of elaborate projects to operate simultaneously, according to Joel Tohline, director of LSU's Center for Computation & Technology, or CCT.

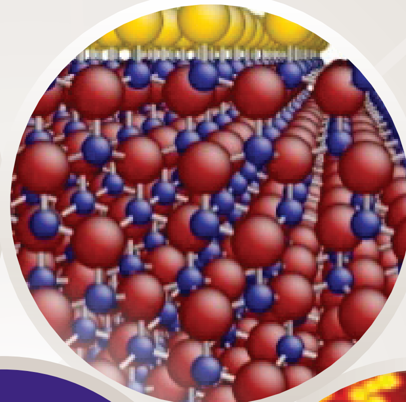
"More than 400 people could use SuperMike-II at the same time," said Tohline. "But our goal is to provide SuperMike-II's services to LSU scientists and engineers who are tackling the most complex problems and require the use of 1,000 or more computational cores at once."

LSU's first supercomputer, SuperMike, was deployed in 2002 as a resource provided by High Performance Computing at LSU, or HPC@LSU, a partnership between CCT and the university's Information Technology Services. HPC@LSU also maintains the Louisiana Optical Network Initiative, or LONI, which connects LSU's supercomputer to five other research universities across the state.

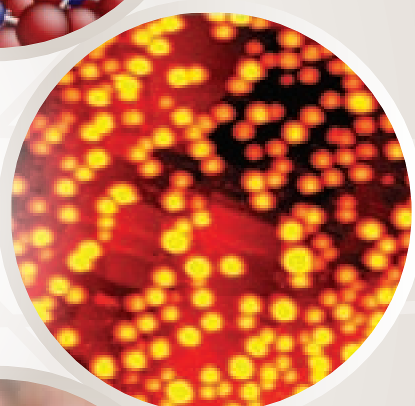
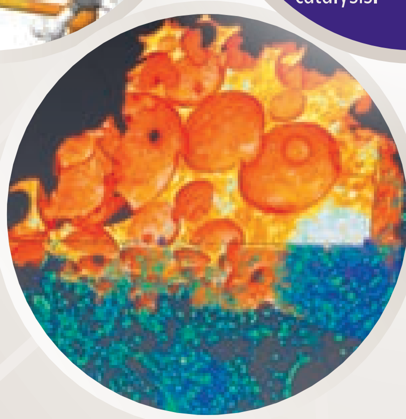


CATALYZING SUCCESS

Materials Science & Engineering


LSU materials science covers the whole spectrum from basic research to engineering and advanced manufacturing, translating research into product. LSU has long been known for its materials science research, especially in the area of catalysis.


by Paige Brown

Materials Research Yields Bright Products

Yi Li is not your average materials science Ph.D. student. A native of China and a recipient of a prestigious Economic Development Assistantship from the LSU Graduate School, Li came to LSU from Florida International University in 2009, attracted by the innovative materials science research conducted at LSU. As a researcher in the laboratory of Ward Plummer and Jiandi Zhang, professors in the LSU Department of Physics & Astronomy, Li started Renogy, a solar solution start-up company and supplier of improved solar energy modules, or solar cells.

"My five years of research at LSU really helped me gain the knowledge required to enter the solar energy industry," Li said. "Applying the principles of materials science in the lab gave me the skills to problem-solve and to apply my knowledge to materials and energy transmission."

Renogy, now housed in the Louisiana Business & Technology Center on LSU's South Campus, provides

Yi Li holding one of her company's solar solution modules at LSU's Louisiana Business & Technology Center.

solar solutions in the form of solar cells. Renogy collaborates with Shangpin Solar, a solar panel factory in Shanghai, China, to create solid state electrical devices that convert the energy of sunlight directly into electricity.

Last summer, Yi Li spent two months at Shangpin Solar researching and checking every step along the production line of her company's solar panels.

"I now understand exactly how the solar panel is made," Li said. "I know which parts I can improve based on my materials science research knowledge."

As a graduate student at LSU, Yi Li worked on thin film technologies such as pulsed laser deposition, or PLD. Thin film deposition techniques used to deposit nanoscale materials that can capture sunlight for energy conversion are key components of the solar cell manufacturing process. Using knowledge developed in the laboratory, Li has created silicon solar cells with improved material surface texturing that improves the output and efficiency of her company's solar panels.

"On the manufacturing side, Renogy also needs to use thin film technologies," Li said. "Because I focused on thin film growth in the laboratory at LSU for so many years, I know exactly how and what techniques are required to improve the quality of our products on the manufacturing side."

Li has also been able to help Shangpin Solar apply atomic-level characterization to their solar panel surfaces, in order to check the quality of the surfaces. Characterization of material surfaces down to the level of atoms is a specialty of materials science research at LSU. Li has helped the factory update their equipment in order to visualize the surfaces of their products.

"The environment at LSU really encourages students to pursue their own research interests," Li said. "The courage to try different things, the team spirit and the training that I gained from the LSU materials science program gave me the ability to pursue the energy business."

Li hopes that someday Renogy, as a pioneer in affordable clean energy and solar solutions, will be able to give back to LSU in the form of funds for research and development, as Li's research experiences at LSU made her company possible in the first place.

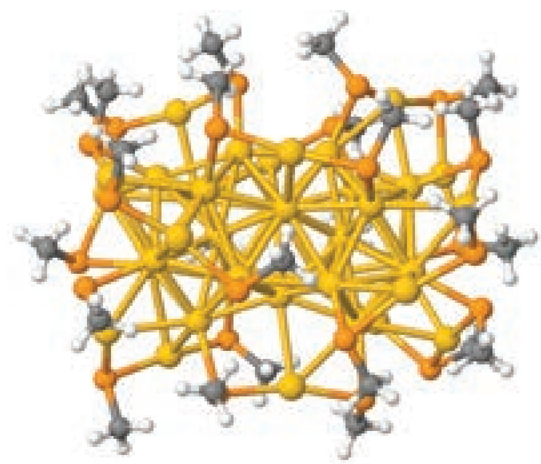
Precision to the Max

In 2009, a materials science research team led by LSU was awarded an Energy Frontier Research Center, or EFRC, by the U.S. Department of Energy. The center, funded by a total of $20 million over five years, is a joint effort among 11 institutions, 20 faculty, and more than 50 post-docs and graduate students.

Research at the center is focused on developing materials engineered precisely down to the level of atoms. These atomic-level materials have applications in energy conversion processes, for example in transforming fuel waste gases like carbon dioxide into cleaner fuels.

The center has the goal of extending the way LSU researchers can make, test and probe materials used as catalysts for energy conversion reactions, among other applications. Catalysts are materials that can speed up chemical reactions — without themselves being consumed in the reaction.

Because of the unique properties that emerge in materials scaled down to the nano-scale, or one billionth of a meter, nanoparticles of various sizes and shapes make excellent starting materials for catalysts. For example, scientists in the EFRC are developing



This image shows a 25 cluster of gold atoms (yellow) that is prepared by LSU EFRC researchers by linking sulfur atoms (orange) with carbon (gray) and hydrogen (white) atoms to gold atoms using specialized techniques. Although gold is normally not an active material in its bulk state, it exhibits unexpected properties when the clusters are this small, for example oxidizing carbon monoxide, a toxic gas, at temperatures below room conditions.

nanomaterials that can better catalyze the reaction removing harmful contaminants from gas streams and other nanomaterials that can convert gasified biomass into ultra-clean liquid fuels.

The center also focuses on making links between experimental research and computer simulations of catalyst-driven reactions at the nanoscale. Merging these two approaches to catalyst design can overcome the limitations inherent in each independent approach.

While preparing catalysts precisely down to the atomic level – for example, preparing a solid surface with isolated clusters of a few copper or gold atoms – is difficult, precise atomic structuring is important to catalyst activity and selectivity. Because catalytically active metals behave in unusual and unique ways when they are in small clusters, researchers must be able to both prepare such materials in sufficient quantities to test and characterize them with precision. By pushing catalyst design down to the atomic level, designing materials atom by atom, researchers can better compare and modify catalyst activity according to computational models of "ideal" materials.

This is what the center is trying to do. An example is shown at left.

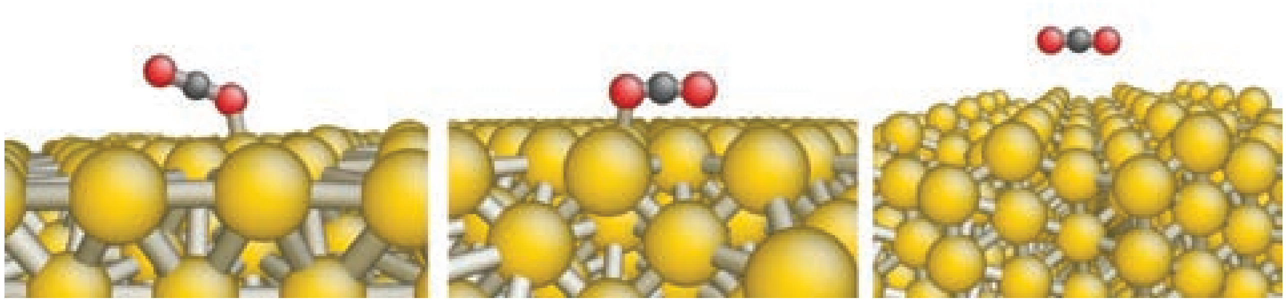
Turning Waste into Work

As global energy demands grow and greenhouse gases threaten climate conditions, there is a need to reduce dependence on fossil fuels and crude oils. Materials science research at LSU is being geared toward producing materials that can catalyze energy conversion reactions and produce cleaner sources of energy.

John C. Flake, associate professor and Cain Professor of LSU's Cain Department of Chemical Engineering, is conducting research at the forefront of energy storage technology. Flake's group is working on electrocatalysts, or special catalysts that function at electrode surfaces, that use electricity extracted from wind or solar sources to turn fuel waste in the form of carbon dioxide back into useable fuels.

"I would love to apply a charge to our system and have gasoline come dripping out," Flake said. "But more realistically, we will make ethanols and methanols that can be further converted into usable fuels."

Flake's group is experimenting with different electrocatalyst surfaces to turn carbonated water into methanol, an extremely valuable substrate for fuels such as gasoline. The group has been successful in using crystalline copper electrocatalysts to reduce carbon dioxide into alcohols. Flake and his materials science colleagues at LSU and beyond are now modifying their catalysts atom by atom to produce higher yields of practical energy products such as methanol while repressing the formation of less favorable products such as ethanol.



Computational representation of a single carbon dioxide molecule (black and red) interacting with copper catalyst surfaces (yellow). Carbon dioxide interacts differently with the different faces of the copper crystal.

"Nobody really understands why certain products are formed more favorably than others during this reaction," Flake said. "People have used trial and error over the years to produce certain favorable products. But we are trying to steer the reactions in the direction that we want them to go. If we can understand how methanol is formed, we can guide the reaction toward the production of this specific fuel product."

Flake's group is collaborating with researchers at Ohio State University, the University of Florida and Penn State in order to merge computational simulations of electrocatalyst surfaces with experimental observations and manufacturing. His collaborators are using computer models run on supercomputers to see how molecules of carbon dioxide, for example, react on a catalyst surface, finding the shape and charge properties of these surfaces that work the best. Flake and his colleagues in the LSU Department of Physics & Astronomy can then make catalyst surfaces that possess the surface properties required to more efficiently convert fuel waste products back into fuels.

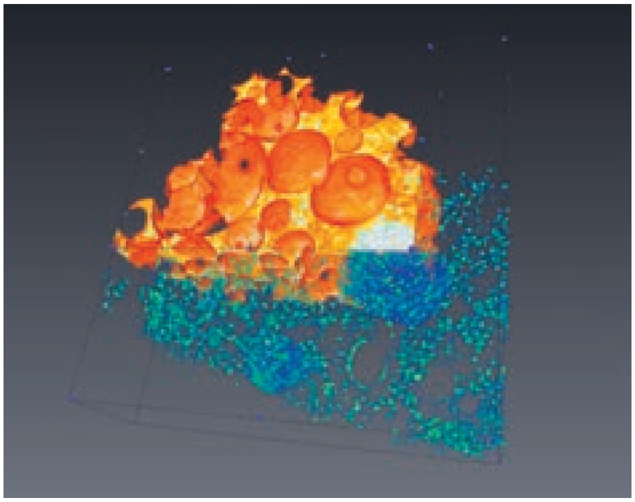
Experimentalists like Flake are now working at smaller and smaller scales to create materials atom by atom, while computer modelers are applying their computer simulations to larger and more complex structures. Where they can meet in the middle, experimentalists and computer modelers can collaborate to inform better atomic-level catalyst design for a range of applications in energy, environment and even bio-materials.

"We are trying to put this all together," Flake said. "Using computational models to predict reactions and how catalysts will look when interacting with various chemicals, we can now go back and make perfect catalysts for our specific application. We are trying to figure out what tricks to play to steer our reactions toward certain products like methanol."

Degrading Materials Strengthen Bone

More than 500,000 bone graft procedures are performed in the United States each year, with grafts intended to fill voids and enhance self-repair of bone defects caused by injury, disease and surgical interventions. However, traditional bone cements used for grafting suffer from an inability to interface well with surrounding living tissues. Traditional bone cements are also not bioactive or biodegradable. In other words, bone cements remain permanently at the site of injury instead of promoting healthy regrowth of surrounding bone tissues.

Daniel Hayes, assistant professor in the LSU Department of Biological & Agricultural Engineering, is working on creating new bone graft materials with superior biologic properties. Hayes is combining materials science principles with stem cell biology to create bone-like materials that automatically mold to the shape of defect sites and degrade over time, thus paving the way for improved repair.



In-situ polymerizing nanocomposite foam developed for the repair of bone trauma. This micro-CT image from CAMD details the nanoscale hydroxyapatite inorganic phase and pore distribution within the thiol-acrylate polymer. Image credit: Daniel Hayes.

These new biocompatible and biodegradable materials, developed at LSU as a joint effort among the LSU Department of Biological & Agricultural Engineering, the Department of Chemistry, the LSU Health Sciences Center and Pennington Biomedical Research Center, provide an alternative to traditional methods of bone repair. Hayes' group is preparing these materials from the bottom up, applying the physics of precise atomic structuring to create foaming materials that harden in place at the defect site to form structures similar to native bone in shape and function within minutes to hours.

"If you don't get the chemistry right, starting with the atomic structure of these materials, then you don't get a good bone-tissue interface," Hayes said. "This is a hierarchical problem. Small defects on the nano- and micro-scales lead to big defects on the macroscale."

Hayes' group uses X-ray crystallography equipment available at LSU's Center for Advanced Microstructures & Devices, or CAMD, along with spectroscopic and electron microscopy methods to observe his materials on both small and large scales. Hayes monitors the structure of his bone foam material down to the level of atoms to ensure that it will form the macroscale interconnected pore structure that allows a patient's bone cells to infiltrate the foam. With the proper structure and biological properties, the bone foam can serve as a scaffold for new bone formation.

"You can't make defined structures if you don't get the atoms aligned correctly," Hayes said. "Without proper atomic structuring, the material just falls apart."

Hayes' bone foam materials are also biodegradable, meaning that as new bone forms at the original defect site, the scaffold slowly degrades and leaves behind only native bone in the repair site.

Using the unique facilities and resources available at LSU for materials science research, Hayes and his students in biological engineering are on their way to creating a new line of bone putties and foams that could literally be sprayed into a wound using a whipped cream-type canister. With the help of fellow materials science researchers at LSU who specialize in the polymer and ceramic components of bone materials, Hayes' group is helping to create the bio-materials of the future.

Facility Resources: Microfabrication & Instrumentation

LSU has unique resources that make competitive materials science research possible, including labs for materials synthesis and characterization on the LSU campus, computer modeling resources at the LSU Center for Computation & Technology and atomic resolution instrumentation at LSU's Center for Advanced Microstructures & Devices, or CAMD.

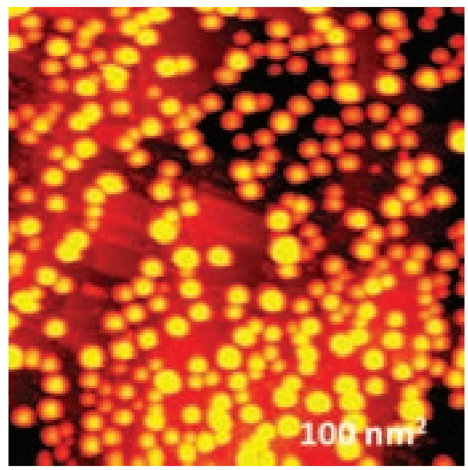
CAMD, established in 1989, is a unique resource in the state of Louisiana for advanced technology in microfabrication and synchrotron sciences. The LSU faculty users of CAMD are among the most productive researchers on campus with a record of exemplary grantsmanship and research accomplishments. In the 2012 fiscal year, LSU users brought in $12.7 million in funding for research projects that rely on measurements made with synchrotron radiation.

CAMD is also a nucleus for competitive federal and industrial grants to LSU that fund research ranging from studies on catalysts for energy efficiency and environmental clean-up applications, to protein structure studies that aid in drug development, to biomaterial studies for cancer therapy. Around one-third of all LSU patents come from CAMD users who have access to synchrotron radiation and instrumentation for rapid turn-around measurements not otherwise available.

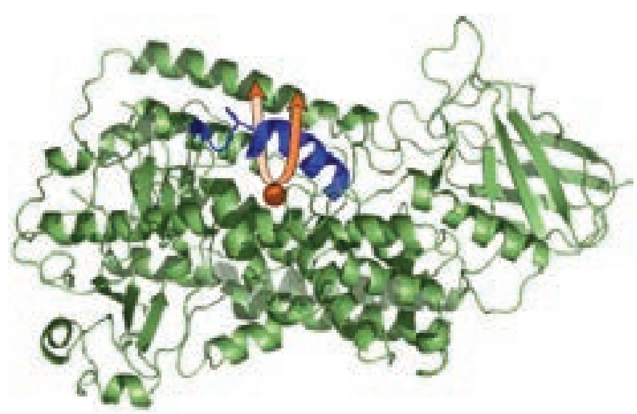
LSU is also leading the way in efforts to create a new cost-shared materials-characterization instrument core to be located on the first floor of the new Chemistry & Materials Building, an 85,348-square-foot laboratory building. The core will contain cutting-edge instruments that can "see" down to the atomic level, allowing researchers to create improved atom by atom catalysts, for example.

The new cost-shared instrument core will be an invaluable resource, not just for CAMD or materials science researchers on campus, but for everyone at LSU. Consolidating instruments currently spread across campus, the core will be an all-in-one facility for fabrication, characterization and testing of new materials.

With electron microscopes for seeing objects smaller than the wavelength of light, focused ion beam instruments for viewing and creating tiny atomic structures, and electron cryo-microscopes for viewing polymers and other biological samples at atomic resolutions, the shared-instrument core will be a center for groundbreaking materials science research. The shared-instrument core is funded and supported by the Louisiana Board of Regents, the National Science Foundation and the LSU Office of Research & Economic Development.



Scanning Tunneling microscope image of gold nanoparticles used to catalyze the conversion of sunlight into energy, taken in the LSU Department of Physics & Astronomy. Catalyst research on gold nanoparticles is done at the Center for Atomic-Level Catalyst Design within LSU's Energy Frontier Research Center.



The three-dimensional structure of this drug target enzyme, which is involved in inflammatory diseases such as asthma, was deciphered using x-ray crystallography at CAMD.

LSU is home to LA-STEM, the Louisiana Science, Technology, Engineering and Mathematics Research Scholars Program for undergraduates.

LA-STEM students at LSU received mentoring and support both in and outside of the classroom, promoting academic success and motivation to excel.

"The future of science in America strongly depends on increasing the number of students in STEM, as well as the quality of their training experiences across the education spectrum," said Vice Chancellor of Strategic Initiatives Isiah M. Warner. "Based on current deficits in STEM teaching in this country, this necessitates a transformation in undergraduate education."

The goal of the LA-STEM Program is to promote the life and diversity of the STEM student body by bringing together students with diverse backgrounds and experiences. The program focuses on providing a supportive and motivating environment for students which promotes academic success through mentoring, education and research.

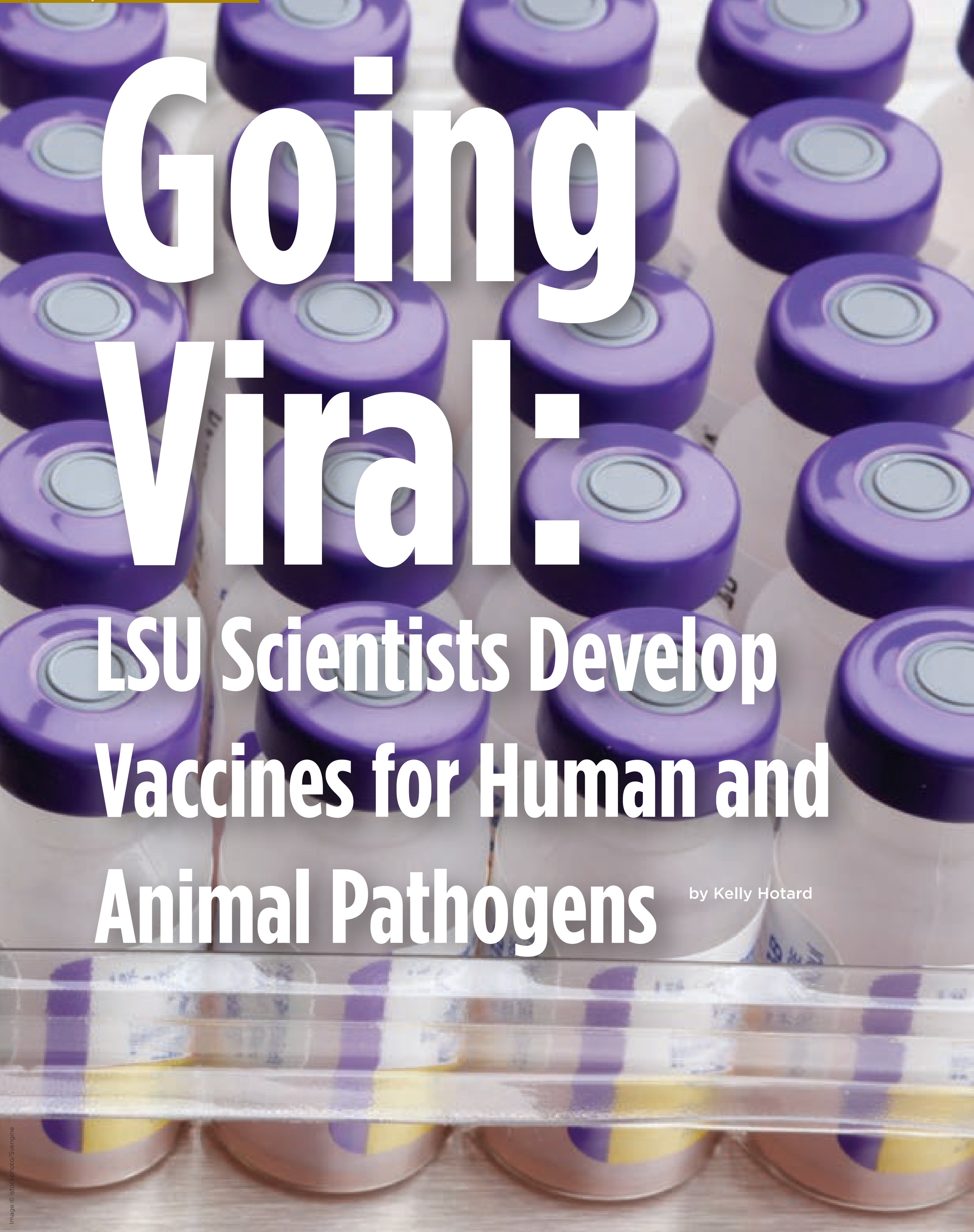
"Mentoring and research have been long recognized as primary agents for transforming undergraduate education in STEM areas," said Warner. "With this hierarchical mentoring model, undergraduate participants are taught the fundamental principles of mentoring, metacognitive learning and research through classes and interactions with LSU faculty, their peers, graduate students, high school students and program staff."

Through funding from the National Science Foundation and the Louisiana Board of Regents, LA-STEM offers a generous scholarship to students, as well as the opportunity to work with top researchers in their field. LA-STEM scholars perform better academically than their peers and are recognized by faculty for their exceptional research abilities. They are also campus leaders, national award recipients and peer mentors. These students have received some of the most prestigious STEM awards available, including the Barry M. Goldwater Scholarship, the Harry S. Truman Scholarship, the Morris K. Udall Scholarship and the NSF Graduate Research Fellowship, among many other awards and accolades.

"The accomplishments of the students in our programs are the greatest testament to the impact of undergraduate research on preparing the next generation of scientists and engineers," said Warner. "We believe that these students are among the future STEM leaders that will positively impact our state and nation."

For more information about the LA-STEM program, visit www.lsu.edu/lastem/.

LA-STEM



Going Viral:

LSU Scientists Develop Vaccines for Human and Animal Pathogens

by Kelly Hotard

Image © istockphoto/Svengine

A key principle of biological science is the interdependence of life – the idea that every living thing on Earth plays a delicately balanced role in the survival of other organisms in the ecosystem.

In the Department of Pathobiological Sciences at LSU's School of Veterinary Medicine, or SVM, researchers examine the damaging domino effects that result when these relationships are disrupted by deadly viruses and diseases. Armed with extensive knowledge of these pathogens, the scientists search for cures and create medicines, often in the form of vaccines, designed to combat the illnesses.

Of course, before vaccines can be introduced for public use, they must undergo rigorous testing and receive licensing permits from the U.S. Department of Agriculture, and pharmaceutical companies must agree to sell and distribute the medicines. It's a lengthy, complex process that begins in LSU's Office of Intellectual Property, Commercialization & Development, which helps the researchers secure patents for their vaccines with the U.S. Patent and Trademark Office.

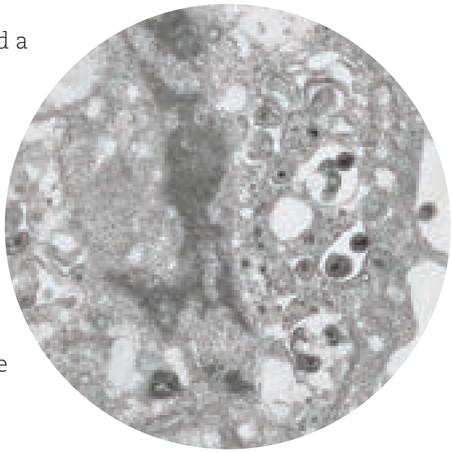
LSU SVM scientists have recently filed three patents for vaccines that treat a wide range of ailments and patients, from respiratory infections in cattle to herpes viruses in humans. Researchers at the school are also working on two projects that will lead to patented vaccines.

Bovine Herpes Virus

Shafiqul Chowdhury, professor of molecular virology, has developed a recombinant vaccine for bovine herpes virus type 1, or BHV-1, a pathogen in cattle that can cause severe sicknesses such as infectious bovine rhinotracheitis and bovine respiratory disease complex, more commonly known as shipping fever. Complications from these illnesses include abortion in pregnant cows, fatal pneumonia and substantial drops in milk production, all of which result in a $500 million annual loss for the U.S. cattle industry alone.

What makes BHV-1 so difficult to treat, Chowdhury said, is the virus' ability to establish lifelong latency after the initial infection. Even the modified viruses used for existing BHV-1 vaccines, in which a gene is deleted from the viral DNA, can resurface at times when the animal's immune system is weakened, such as during periods of stress.

Chowdhury's vaccine, however, contains an engineered virus lacking the envelope proteins that suppress immune response. This virus also cannot reactivate from latency.



"Recently, we have completed a small-scale vaccine efficacy study and compared our vaccine candidate relative to the current gE-deleted marker vaccine," said Chowdhury. "Based on the results, calves vaccinated with our vaccine induced considerably improved protective immune response when compared with the current vaccine."

The Chowdhury laboratory, with support from Elanco, a global animal health company, is now developing a serological marker test for the vaccine, which is required for the European market.

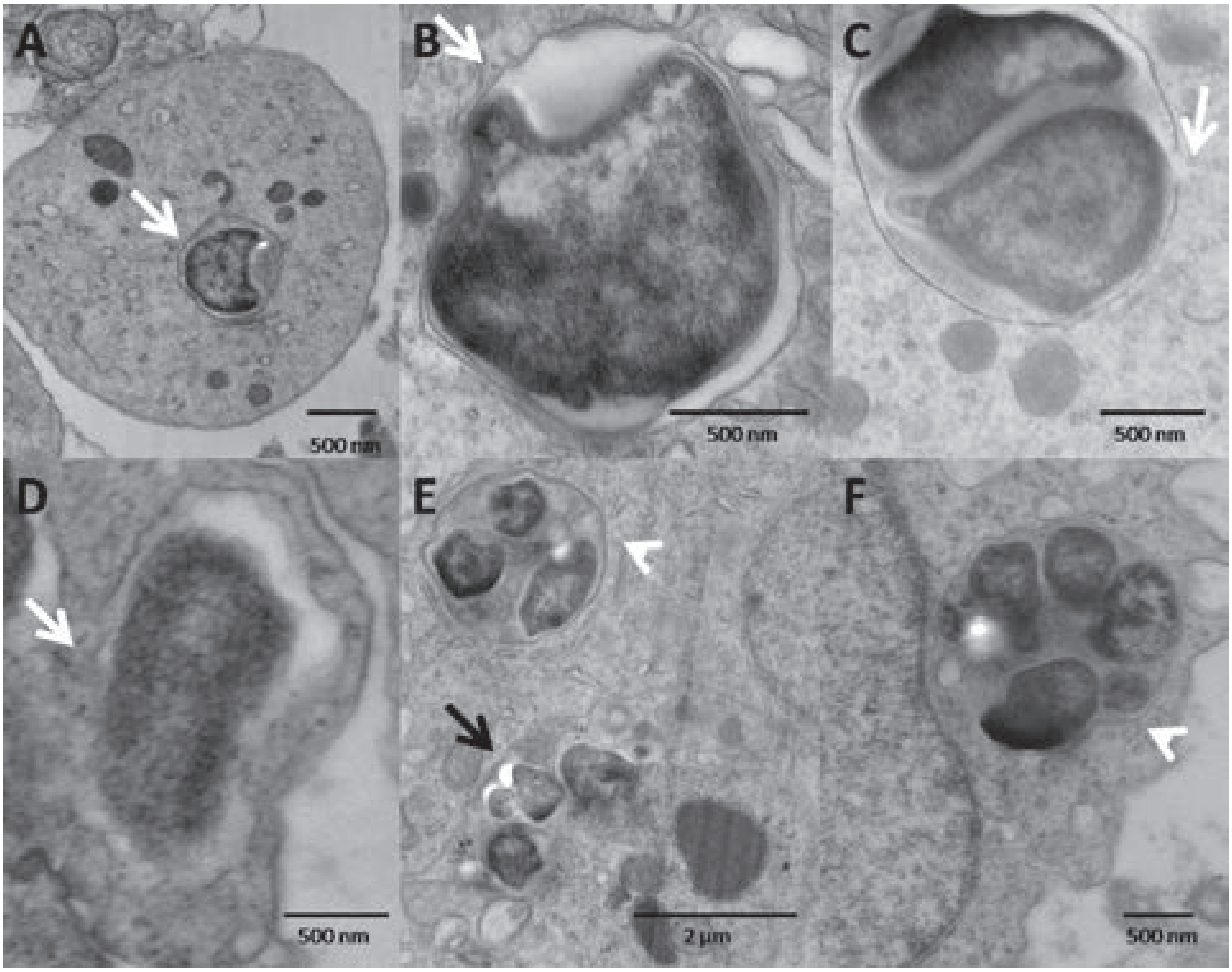
Francisellosis

LSU SVM researchers treat all manner of animals, both on land and under water. John Hawke, professor of aquatic animal health, along with former LSU graduate student Esteban Soto, has created a vaccine that protects warm- and cold-water cultured and wild fish, such as tilapia, against *Francisella*, a species of emergent bacterial pathogens. In recent years, these bacteria have caused acute to chronic disease and even widespread mortality among fish in the United States, Taiwan, Costa Rica, Latin America, Norway, Chile and Japan.

Because tilapia are a hugely marketable food commodity, they are raised in farms all over the world. This high-density environment, however, also makes tilapia more susceptible to francisellosis. The disease produces tumor-like granulomas in the fish's liver, spleen and kidney.

Hawke's vaccine is a live-attenuated mutant form of the parent bacteria strain, capable of infecting the fish with a mild form of the disease that is cleared in a short period of time. The induced immunity generates a heightened cellular and long-term humoral response to *Francisella* in the fish.

Vaccinating tilapia is quite unlike inoculating humans or other animals. Rather than injecting the fish directly, the



Transmission electron micrographs of tilapia head kidney-derived macrophages infected with *Francisella asiatica* LADL 07-285A. (A and B). After uptake, the bacteria are located inside a membrane-bounded tight phagocytic vacuole (white arrow) within the macrophage. (C and D) Breakdown of the phagosomal membrane (arrows) appears to allow *F. asiatica* access to the cytoplasm at 6 to 12 h postinfection. (E and F) After 12 h, several bacteria are found inside a spacious vacuole (arrowheads), and some appear to have escaped to the cytoplasm (arrow).

vaccine must be administered into the water. Month-old fingerlings are then immersed in the water, where they take in the vaccine through their gills and skin directly into the bloodstream. Hawke's vaccine usually affords the fish at least a year of protection from francisellosis.

"The vaccine would be part of an overall health management system that would include biosecurity, improved husbandry practices, proper nutrition and water quality management," said Hawke. "The goal is to reduce the dependence on chemicals and antibiotics in fish production."

Hawke is seeking to partner with a pharmaceutical company to distribute and market the vaccine.

Enteric septicemia

Ron Thune, who heads the Department of Pathobiological Sciences and is also a professor of aquatic animal health, has been making significant strides since the late 1990s on vaccines that protect catfish from a serious bacterial pathogen called *Edwardsiella ictaluri*. This pathogen causes a disease known as enteric septicemia of catfish, or ESC, which can cost the aquaculture industry as much as $40 million a year.

Thune began by testing a killed vaccine against *E. ictaluri*, which showed low efficacy against the virus and required multiple exposures. But by studying the rapidly invasive nature of the pathogen during these trials, Thune was able to develop a live-attenuated vaccine that could inject itself into the catfish and provide strong protection against *E. ictaluri*. A patent application was created, but because the vaccine strain only persisted in the fish tissues for two to four days, the product could not be successfully transitioned to field conditions and produced for commercial use.

"It became apparent that a deeper understanding of the way this bacterium causes disease is required," said Thune. "So, during the next several years, with funding from the USDA's competitive grant programs, we developed a model that began to explain the process. At present, the model explains the initial stages of infection, when the bacterium establishes itself as an intracellular pathogen in host immune cells known as macrophages."

Thune's ongoing research entails establishing subsequent stages of the infection, when researchers believe the bacterium is able to manipulate the metabolic activity of the host cell to the bacterium's advantage. This has already led to the development of an initial live vaccine strain that persists longer after vaccination without causing disease and is effective following a single immersion exposure. Further research suggests the initial strain can be improved, and Thune is working toward this goal.

Herpes simplex

While the above epidemics affect people in an indirect way, LSU SVM researchers also develop remedies for human ailments. Konstantin G. Kousoulas, professor of virology and biotechnology and director of the SVM's Division of Biotechnology & Molecular Medicine, has engineered a vaccine that protects against herpes simplex infections.

"Our herpes simplex virus vaccine is based on our work toward understanding how the virus enters into cells and spreads from one cell to others," said Kousoulas. "The hallmark of herpes simplex virus infections is that the viruses enter neurons, where they stay latent. The virus reactivates from latency upon exposure to an external stimulus such as stress during exams, heat or the general status of the immune system."

The Kousoulas laboratory found that modifications in viral glycoprotein prevent the virus from entering neurons, both in cell cultures and in animal experiments. Kousoulas' vaccine, which contains a weakened virus that does not express this glycoprotein, protected mice from lethal challenge of herpes simplex.

"Having a live-attenuated vaccine that is safe, since it will not enter into the neurons, is the most attractive aspect of this vaccine," said Kousoulas. In addition, Kousoulas' vaccine, unlike existing herpes remedies, may also be used for therapeutic treatment of recurrent infections in people who have previously contracted the virus.

Kousoulas expects the vaccine-protection studies will be published soon.

Onchocerciasis and lymphatic filariasis

LSU is one of four universities collaborating on a more than $5 million project supported by the National Institutes of Health to develop vaccines for two neglected tropical diseases, or NTDs, called lymphatic filariasis and onchocerciasis, or river blindness. These illnesses are caused by nematode parasites and are usually transmitted to humans through mosquito bites. While lymphatic filariasis and onchocerciasis are severely debilitating on their own, they can also increase susceptibility to fatal diseases such as HIV/AIDS, malaria and tuberculosis.

The groups of researchers are producing a series of molecularly defined parasitic proteins in two animal models – the human parasite *Onchocerca volvulus*, a causative agent of river blindness, and *Brugia malayi*, a causative agent of lymphatic filariasis – that will be tested for efficacy in guarding against experimental infections. Molecularly defined vaccines against nematode parasites do not currently exist, and the vaccines being used to disrupt transmission of the diseases have shown signs of ineffectiveness because the parasites are growing resistant to them.

Thomas Klei, Boyd Professor of Parasitology and Veterinary Science and interim vice chancellor of research and economic development, is principal investigator for LSU's portion of the team, which maintains a life cycle of *B. malayi* and conducts experiments with these recombinant proteins.

"Onchocerciasis and lymphatic filariasis are devastating diseases to hundreds of millions of people in tropical developing countries of the world," said Klei. "These are mostly poor populations and diseases unique to them are generally neglected as compared to conditions of the developed world, hence the categorization of 'neglected tropical diseases.' A vaccine designed to greatly reduce the prevalence of NTDs would be an enormous step forward in improving world health, and our team is making progress in this direction."

Klei said when the researchers find significant protection in both models of the molecularly defined proteins, phase one trials for safety in humans can begin.

Whether people will benefit directly or indirectly from these vaccines, the innovative work of scientists at LSU's School of Veterinary Medicine will continue to have a profound impact on our world.

Going… Going…

by Zac Lemoine

Deep in the marshes and bayous of Louisiana, the sounds of millions of insects, hundreds of frogs and other creatures can be heard buzzing, croaking and splashing through one of the most ecologically diverse ecosystems in the United States. Today, three years after the Deepwater Horizon blowout, those sounds — once deafening — are less common.

Like many researchers at LSU, Linda Hooper-Bui, associate professor in the LSU Department of Entomology, who primarily researches ant colonies, focused her research efforts on the impact of the estimated 4.9 million barrels of oil released during the Macondo well event.

"We are working in the salt-water marshes and coastal dunes," said Hooper-Bui. "We're asking questions related to stressors. It's not just oil, it's oil dispersants, cleanup activities and whatever restoration plans are in progress … all of this is factored in."

The oil spill is not what brought Hooper-Bui to the coast of Louisiana. She had been studying ant colonies in the marshes for years as part of a larger group, looking holistically at the changes in the Gulf area. They have benchmark data to measure the impact of sea level rise, land subsidence, marsh destruction or restoration and climate change.

Linda Hooper-Bui and her group studies ant colonies living along the coast of Louisiana. After the Deepwater Horizon oil spill in 2010, she has seen a striking decrease in ant populations.

This data, collected before the oil spill and after in oiled areas and similar unoiled reference sites, offer a great deal of information on the changes in the marsh ecosystem. According to Hooper-Bui, her team has seen native species decrease and invasive species fluctuate.

"Our work is focused on insects," said Hooper-Bui. "Mainly we focus on ants, because ants are closely associated with the soil and plant life."

Because of the substantial devotion of resources and time, research relating to the oil spill has become the primary focus of a number of researchers, who often adapt or postpone their regular research. Because of the all-encompassing nature of the oil spill research, some have jokingly begun to refer to each year as a season, much like a television show, with April 2010 to April 2011 serving as the premiere season.

With the close of spill season one, the data collected by Hooper-Bui and her colleagues proved invaluable in measuring the immediate impact of the oil on the Gulf ecosystems and the lasting changes that are still unfolding today.

"In oil spill season one, we saw a radical decrease in almost every species we looked for — these include insects and spiders," said Hooper-Bui. "It was catastrophic."

While direct contact with the oil could have had devastating effects on the food chain, which could have led to the death of the insect populations, evidence suggested that other factors were involved.

In order to better measure the impact oil had on insects, Hooper-Bui and her team constructed cages designed to float in the marsh area. The cages included food and, as a result, were entirely self-sustaining. Essentially, the insects in the cages were only coming in contact with the air in the marsh.

"The marsh is often covered with water because of tides and wind-driven water, but there are times when there is a low tide or a strong north wind that the sediment is exposed," said Hooper-Bui.

The exposed sediment is key to what she believes is killing the insect populations.

When the waters are pushed back or withdrawn due to tide, a scene appears that's very different from the wind-swayed cord grass rising up through the brown waters of the coast. What emerges looks similar to cracked pavement.

A hardened surface of oil paves the sediment along the coastline. The pavement-like top is made of long strand hydrocarbons, weathered by the mile-long journey from the Macondo spill and the dozens of miles it traveled through the Gulf to reach the Louisiana coast. Add exposure to the sun and, while unsightly, it's not too harmful to the plant and animal life because most of the harmful toxins have been stripped away or weathered to acceptable levels. However, what remains under the hardened surface is another story.

When the surface is exposed, the sun heats the dried oil to the point of cracking, exposing the softer oil beneath. The oil bubbling up through the cracks is less weathered and contains many of the short strand hydrocarbons — it's this unweathered oil that Hooper-Bui believes is causing the drastic drop in insect life.

Using the cages of insects, Hooper-Bui tracks insects along the coastline and 60 feet in from the coast. The differences were drastic. In 2010, immediately following the spill, there was a 60 percent drop in insects closest to the coast. Hooper-Bui's team found 30-40 insects per sample 60 feet inland, and only 10 insects per sample along the coast.

While the impact was drastic in the first year, Hooper-Bui expected insect life to spring back, but that didn't happen. In 2011, the inland sites remained the same, but the insects populations along the coast dropped again — to a third of a bug per sample. Her most recent samples, taken in April, show no insects along the coast in oiled areas.

"We've heard the oil coming into the marsh is so weathered it's non-toxic … well the insects are telling us something different," said Hooper-Bui. "The insects are dying and they're not coming in contact with anything but the air. There is something toxic. This is the canary in the coal mine."

Modular Capping

by Ashley Berthelot

MWCC Capping Stack © Marine Well Containment Company

The Deepwater Horizon Oil Spill of 2010 brought with it as many lessons as it did tragedies. Now that more than two years have passed since the loss of 11 lives, severe damage to Gulf ecosystems and devastation to the livelihood and well-being of many coastal residents, researchers have had time to look back at the events that unfolded at the site and think, what can we do better? How can we avoid a tragedy of this magnitude again?

"One of the biggest problems with the Macondo event was that it took so long to get the capping and containment equipment on site and in action," said John Rogers Smith, LSU associate professor of petroleum engineering. "Macondo made it clear that capping systems need to be developed and stored ready for use if we are to consider the industry as being well-prepared."

Smith, along with Adam T. (Ted) Bourgoyne Jr., professor emeritus, and Ted's son, Darryl A. Bourgoyne, current director of the university's Petroleum Engineering Research and Technology Transfer Lab, had long been interested in working on the development of a modular capping and containment unit – sort of a mobile first aid kit for well events. Funding, however, had been an issue. After the Macondo blowout, though, BP came through with a modest amount of support, and the project began to take shape.

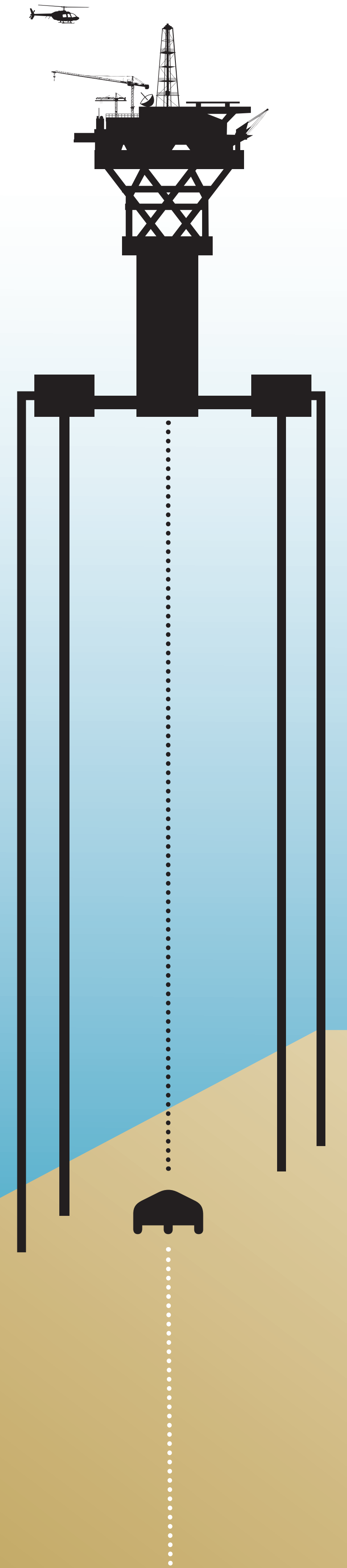
The goal? To develop a thorough, detailed list of design considerations for a generally-applicable capping stack … in other words, a universal "fix it" for well blowouts.

Louise M. Smith, a graduate student working with Smith, took on a key component of the project, which culminated in her thesis analyzing all blowout and well-related leaks and spills that occurred in the Gulf of Mexico from 1996-2010.

"What we found through this analysis was that these events occur over the entire life of a resource," said Smith. "Problems have happened during a sea floor investigation before drilling the actual well had even begun all the way through to issues found on wells that had already been permanently plugged and abandoned."

Because the likelihood of an event is so widely distributed across the lifespan of these resources, determining the components necessary to have on-hand in case of disaster is that much more complicated.

"A truly universal capability would require knowing exactly what kind of equipment is on the sea floor at every stage of every well's development," said Smith. "That way, the equipment interfaces could be defined and available to connect emergency cap-and-seal technology with any leaking well."



Capping and containment systems for deepwater wells, which did not exist prior to the Macondo incident, are being rapidly developed by industry with initial capping systems now available from at least four separate organizations. However, most of those efforts have focused on being able to respond to events that occur during drilling operations. That focus is logical given that drilling accounted for about two-thirds of all of the blowouts identified in the study, but the remaining range of scenarios must also be considered. This is where the LSU project comes in.

Louise's thesis, titled "A Review of Offshore Blowouts and Spills to Determine Desirable Capabilities of a Subsea Capping Stack," identifies the operations, flow paths, leak points, response attempts and response success rates for the 90 incidents that happened in the Gulf over the last 15 years. Consequently, this analysis, available at LSU's Middleton Library, provides the basis for identifying a collection of modules to cap, collect, contain or intervene effectively to regain control of a well.

The current project to define those modules is now in its final stages. An interim report and the thesis have gone to BP. Two papers and several presentations have delivered the results to a variety of audiences. The research team conducting this work also includes Muhammad Zulqarnain, a graduate student working on the module design specifications; Julius Langlinais, professor emeritus; Kyle Matthews, a senior; and Mayank Tyagi, assistant professor, who developed the accompanying software to allow engineers to check the flow rate capacity of the modules; and Lauren Pattee, a recent graduate who helped describe seafloor equipment.

A limitation of this work is that it uses historical data and experience to project future needs. However, deepwater operations and subsea equipment are a relatively new and rapidly evolving technology, so previous precedents do not always exist.

"How do we really anticipate possible future problems with systems that we just don't have much history with?" asked Smith. "If we study these new systems more carefully from a reliability and risk perspective, we have the potential to reduce the probability of future events. That's where engineering can really pay off."

PERTT

Petroleum Engineering Research & Technology Transfer

by Ernie Ballard

There is only one university in North America where future petroleum engineers can get hands-on training in well control by working at a full-scale well control research and training facility – and that university is LSU.

The Petroleum Engineering Research & Technology Transfer, or PERTT, Laboratory – also commonly referred to as the Well Facility – is an industrial-scale facility with full-scale equipment and instrumentation for conducting training and research related to borehole technology.

"We believe it's a really important and unique resource that we have here at LSU," said John Rogers Smith, associate professor of petroleum engineering and holder of the Campanile Charities Professorship of Offshore Mining and Petroleum Engineering. "We're the only school in the United States that offers and requires hands-on training in well control and understanding hydrostatics and pressure control in wells using actual wells."

The lab, run by the Craft and Hawkins Department of Petroleum Engineering in the LSU College of Engineering, was commissioned in the early 1980s. Since then, it has been utilized as a training facility for both students and industry professionals.

"They're learning from the real behavior of real fluids – mud and natural gas – in real wells using real equipment, so the behaviors that they see are not just theoretical or something that's generated from a training simulator," Smith said. "The confidence that they get from working on real equipment – operating real pumps and real chokes – we feel gives our students a unique experience while they're here."

When the PERTT Lab was developed, much of this equipment was assembled to support past research and training activities in the area of blowout prevention. Now the lab is used to provide a versatile research environment for performing multiphase flow experiments on field scale tubulars at high pressures.

"This facility is a full-scale facility that provides some very unique learning opportunities for our engineering students, not only in terms of the classes they can take here, but we do have a rather large part-time student staff that helps maintain it, so they actually get to reduce a lot of what they are learning in class into practice," said Darryl Bourgoyne, PERTT Lab director. "It helps them understand the work that they're going into. They are actually exposed to it, and the full-time staff out here can take time to work much more one-on-one with students in a real application setting and work on the skills to implement and work as a team."

Smith and Bourgoyne bring years of industry experience and knowledge as drilling engineers to the classroom and hope to be able to pass that experience on to their students.

"We both continue to be involved with research and help our industry colleagues as we develop new techniques, and we develop new equipment," Smith said. "We try to take advantage of what we've learned, what we know has been important to us in our careers in terms of what we try to deliver to the students, and we also try to take advantage of new knowledge that has been developed to improve what the students are learning."

Smith said they focus on fundamental concepts and techniques that students can use in multiple ways to tackle the problems they may encounter in the field. The teaching of fundamentals and being able to adapt those ideas is important for preparing students for the workforce.

"The fact that LSU has this long tradition of generating engineers that are ready to go to work when they graduate has helped maintain the quality

Professor John Smith explains PERTT operations to the media at a demonstration during the 2010 oil spill.

and the magnitude of the recruiting that's done at LSU by major companies," he said. "It has contributed to this high employment rate that our new graduates have and helped them to take advantage of the high starting salaries that engineering graduates have nationwide as a profession."

In addition to training with real equipment at the PERTT Lab, students also get training on computer simulators that are designed for well control. Students take a one-semester course at the PERTT Lab where they complete a number of exercises to learn to operate equipment, such as pump startup and shutdown, and simulations of real operations from the field, such as pressure testing on casing and on formations, which are simulated full-scale. Other exercises include circulating fluid through pipes to see how pressure changes, simple fluid mechanics and controlling pressure on the well after taking a kick.

"We try to give the students a good combination of the hands-on experience with the real equipment," Smith said, "and tie in back to the theories that they're learning so that they'll be able to then go apply the theories and concepts in the field to situations that they're going to encounter that will be different than the ones we've shown them."

Training in the PERTT Lab provides students with practical information they wouldn't necessarily get from a textbook or classroom setting.

"Classroom learning is where things start, but everybody learns differently," Bourgoyne said. "They learn a lot of the things you wouldn't necessarily cover in the classroom – how to stay safe in an industrial environment, a lot of the practices we use to communicate and transfer responsibility from one person to another for essential operations – a lot of these logistical problems that are not necessarily technically challenging but nonetheless are very important and required."

The PERTT Lab was established at LSU by Ted Bourgoyne, professor emeritus of petroleum engineering, and several other faculty members in the early 1980s with funding from the U.S. Minerals Management Service, or MMS; industry; and LSU. Much of their research, especially Bourgoyne's work, continues to be relevant and useful today.

"The well that we're working with today was subsequently drilled in the mid-1980s as an industry-funded research well," Smith said. "Dr. Bourgoyne, our staff and students, including Dr. Allen Kelly, and industry researchers conducted the experiments. The research and the results of the experiments that were done with the well are still the most valuable set of well control data from real experience with a variety of conditions and mud types that exists. We're still using that data in our research today. We're still providing it to other people as a unique resource that doesn't exist anywhere else."

In addition to training students and industry, the PERTT Lab is a place where new technologies can be safely tested before they are launched in the field.

"The LSU well facility, with 30 years of history, continues to be a unique resource for the industry and our profession," Smith said. "This is a place where we can come safely try out new ideas, new equipment, find what works, and find how to make them better, before we take those new technologies to the field."

To view a video of the PERTT Lab, scan the QR code on your smart device.

Going the Distance

In recognition of exceptional achievements in research and scholarship, the LSU Office of Research & Economic Development, or ORED, presents the Distinguished Research Masters Awards each year. Two faculty members are selected as Distinguished Research Masters, and the LSU Alumni Association and the LSU Graduate School recognize two graduate students with the Distinguished Dissertation Award. Both awards honor recipients for their academic efforts.

This spring, Suzanne Marchand and Kalliat Valsaraj were both recognized as Distinguished Research Masters, and graduate students James Weldon Long and Nathaniel Carson Gilbert were presented with Distinguished Dissertation Awards.

Distinguished Research Masters Recipients

Suzanne Marchand

Marchand, a professor in the Department of History in LSU's College of Humanities & Social Sciences, received her bachelor's degree in history from the University of California, Berkeley and a master's and Ph.D. from the University of Chicago.

"It is a great privilege to teach at LSU and a delight to be honored for doing the research and teaching I love," said Marchand. "What I have accomplished here has been made possible by the continuous support of my colleagues, department chairs and deans, as well as the staff of the College of Humanities & Social Sciences and by the amazing staff at Middleton's interlibrary loan department. I have also been inspired over the years by a decade and more of great LSU undergrads and grad students, and I am looking forward to teaching more wonderful students in the years to come."

She is author of "German Orientalism in the Age of Empire," which, in 2010, was honored by both the American Historical Association and the American Library Association, as her work received the George L. Mosse Prize and was named as one of the "Outstanding Academic Titles of 2010." The book challenges Edward Said's influential theory that modern studies of the Orient are all rooted in Western imperial hubris.

Marchand is also the author of "Down from Olympus: Archaeology and Philhellenism in Germany, 1750-1970," and is co-author or editor of "Proof and Persuasion: Essays on Authority, Objectivity & Evidence"; "Worlds Together, Worlds Apart: A History of the World from the Beginnings of Humankind to the Present"; and "Germany at the Fin de Siècle: Culture, Politics, and Ideas," as well as approximately 40 articles and book chapters.

"Sue is not only frequently honored but constantly asked to participate in various conferences around the country and in Europe," said Gaines Foster, dean of the College of Humanities & Social Sciences. "In addition to being an internationally respected scholar, Sue is a dedicated teacher; she is particularly skilled in training graduate students, and if all that were not enough, she is an ideal university citizen and wonderful colleague."

Marchand is currently vice-president of the German Studies Association and will serve as president in 2013-14. Marchand also serves on the American Historical Association's Committee on Committees and is the first U.S. representative on the German History executive board. She has also previously been selected as an LSU Rainmaker; received a prestigious summer fellowship at Collegium Budapest; received an American Council of Learned Societies, or ACLS, Burkhardt Fellowship for associate professors; and received many other honors, fellowships and awards within her field.

Kalliat T. Valsaraj

Valsaraj currently holds several honorific titles, including the Ike East Professor of Chemical Engineering and the Charles and Hilda Roddey Distinguished Professor in Chemical Engineering, both within LSU's College of Engineering. In addition, he serves as associate vice chancellor of the university's Office of Research & Economic Development, or ORED. Valsaraj received his bachelor's degree in chemistry from the University of Calicut in India. Continuing his studies, Valsaraj went on to receive a master's degree in chemistry from the Indian Institute of Technology in Madras, India, and he completed his Ph.D. at Vanderbilt University. Prior to his administrative role at ORED, Valsaraj served as chair in the Cain Department of Chemical Engineering at LSU.

"I feel truly honored and humbled by the recognition from my own peers at LSU," Valsaraj said. "I am extremely proud of the achievements of all of my students, post-doctoral researchers and co-investigators who have made this possible for me. LSU is a great place for research, and I feel blessed to be associated with this university."

Valsaraj has published more than 180 peer-reviewed journal articles, more than 25 book chapters and has presented his research at numerous conferences across the globe. Additionally, he has published three solutions manuals and five books, including three editions of "Elements of Environmental Engineering: Thermodynamics and Kinetics," along with "Atmospheric Aerosols: Characterization, Chemistry and Modeling," and "Photocatalytic Reaction with Inverse Opal Catalyst: A Method to Solve Air Pollution via Photocatalysis." Valsaraj is responsible for a number of high-profile research grants, and he counts among his honors being named a fellow of both the American Association for the Advancement of Science, or AAAS, and the American Institute of Chemical Engineers, among others.

Since 1972, the LSU Council on Research has proudly presented the Distinguished Research Master awards in recognition of outstanding faculty achievements in research and scholarship. Nominations are open to the university community, and the council chooses recipients from a list of deserving nominees proposed each year by faculty colleagues. Nominations are made in the categories of engineering, science and technology; and the arts, humanities and social sciences.

The Distinguished Research Master Award recipients receive a salary stipend and the University Medal – the symbol of exceptional academic accomplishment at LSU.

Distinguished Dissertation Award Recipients

The LSU Alumni Association and the Graduate School sponsor the Distinguished Dissertation Awards, presented annually since 1983. The awards, given in two categories, are given to doctoral students whose research and writing demonstrate superior scholarship.

Josephine A. Roberts Alumni Association Distinguished Dissertation Award in Arts, Humanities & Social Sciences

James Weldon Long

James Weldon Long was born and raised in San Antonio, Texas. In May 2004, he graduated from the Honors Program of St. Mary's University in San Antonio with a Bachelor of Arts degree in English, after writing a senior thesis on Thomas Pynchon's classic postmodern novel "Gravity's Rainbow." He received a Master of Arts degree in English from LSU's College of Humanities & Social Sciences in May of 2006, completing a master's thesis on the works of Herman Melville and Joseph Conrad.

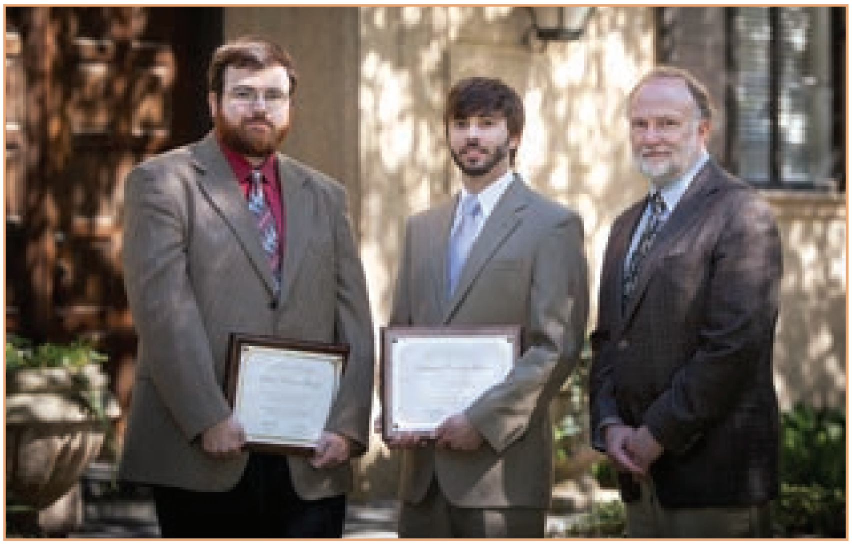
Long's dissertation explores the transformation of United States-Latin American relations in the 19th century shortly before the Mexican War. He draws from a variety of sources to create a persuasive and insightful account of this critical period of history. His research on this subject has already resulted in four published essays in scholarly journals, and his work should make an important contribution to reassessment of U.S. cultural history.

LSU Alumni Association Distinguished Dissertation Award in Science, Engineering & Technology

Nathaniel Carson Gilbert

Nathaniel Carson Gilbert, native of Monroe, La., received his bachelor's degree from LSU in 2006. He then joined the lab of Marcia Newcomer, professor of biological sciences, in LSU's College of Science. Gilbert's dissertation describes the enzyme involved in the inflammatory response that mediates the human body's protection from pathogens. His work included the crystallographic structural refinement of the molecule as well as the biological effects. Two major papers resulted from his research, one in *Science* and one in *Science Translational Medicine*. His discoveries hold great promise for their impact on future studies of cancer and cardiovascular disease. Gilbert is now a post-doctoral fellow at Vanderbilt, where he is conducting research on the EP3 receptor.

Graduates at any of the three commencements in a calendar year are eligible for nomination for the Distinguished Dissertation Awards. A committee of the graduate faculty selects the winning dissertations. Award recipients receive a monetary gift and a certificate of commendation.



Rainmakers

At a top-tier research university like LSU, the work and contributions of faculty members extend far beyond the classroom. Academic researchers must balance teaching and departmental responsibilities, along with external expectations such as securing funding for their research and publish their findings for the benefit of the scholarly community and society as a whole.

LSU has a wealth of faculty who accomplish these tasks exceedingly well, demonstrating superior drive and passion for both the areas they study and the students they teach. Each year, the university's Office of Research & Economic Development, or ORED, with the support of Campus Federal Credit Union, finds and honors these high achievers with LSU's Rainmaker Awards for Research and Creative Activity.

Rainmakers are those faculty members who garner national and international recognition for innovative research and creative scholarship, compete for external funding at the highest levels and attract and mentor exceptional graduate students. These outstanding faculty represent a vast range of research areas, from mechanical engineering to communication studies, and exhibit excellence at every stage of the academic career, from rising researchers to seasoned scholars.

"We are proud to recognize those faculty members who are so integral to our success as an institution," said Thomas Klei, LSU interim vice chancellor of Research & Economic Development, who presented the awards in a ceremony at the Faculty Club in April. "These researchers and creative scholars truly exemplify what it means to be an LSU Rainmaker. We couldn't do this without the support of Campus Federal Credit Union, and we thank them for their support of our commitment to scholarly excellence."

Ron Moreau, vice president of business development and community relations at Campus Federal, was also on hand to congratulate the recipients.

"We [Campus Federal] understand the important role research plays in LSU's long-term success," said Moreau. "But more importantly, we admire the dedication and diligent efforts of so many LSU faculty who use research and innovation to improve the quality of education for all students. Campus Federal was founded by seven distinguished LSU faculty members in 1934, and it seems only fitting that we support the distinguished faculty known as Rainmakers for their accomplishments in research today."

Each of the following award-winning faculty members has met one or more of the criteria for high-quality research or creative activities and scholarship, which include, but are not limited to: publication in a high-impact journal(s); a highly cited work; external awards; invited presentations at national and international meetings; high journal publication productivity; critically acclaimed book publication(s), performance(s), exhibit(s) or theatrical production(s); high grant productivity; and, for more senior candidates, outstanding citation records and high-impact invited presentations at national and international meetings.

Emerging Scholar Award

This award recognizes junior faculty members who have accomplished outstanding research or creative productivity and scholarship in his or her field, typically in fewer than eight years at the assistant or associate professor level.

This year's Emerging Scholars are:

Tim Slack, associate professor of sociology, received the Emerging Scholar Award in Arts, Humanities and Social or Behavioral Sciences. Slack's research, which explores social stratification and demography with emphasis on economic and spatial inequality, has earned grants from the National Science Foundation, the U.S. Department of Agriculture and the U.S. Department of the Interior. This funding allows Slack and his research team to study social and regional issues such as place-based poverty dynamics, household livelihood strategies and disaster vulnerability and resilience.

"The current policy-making context is a hyper-ideological one," Slack said. "But we live in an age when the availability of social and economic data and methods for social scientific analysis have never been better. Daniel Patrick Moynihan is quoted as saying, 'Everyone is entitled to his own opinion, but not his own facts.' I'd like to see my work contribute some of those facts to help inform collective decision making."

Slack said he feels extremely honored to receive the Rainmaker Emerging Scholar Award. "Having colleagues both inside and outside of LSU provide me special recognition for my early career work is humbling," said Slack. "I certainly could have never realized the success that I've had without being lucky enough to be associated with some really great colleagues and students."

Ying "Jane" Wang, assistant professor of mechanical engineering, received the Emerging Scholar Award in Science, Technology, Engineering and Mathematics. Wang's area of research focuses on novel synthesis of nanomaterials and ultrathin films for high-performance solar cells, advanced lithium-ion batteries and efficient oil-spill cleanup applications. Wang has published 29 journal papers

The 2011 LSU Rainmakers [from left to right]: Dawn Harris, COO Campus Federal, Milen Yakimov, James Honeycutt, Tim Slack, Ying Wang, and Interim Vice Chancellor Thomas R. Klei.

and 12 conference proceedings, which have received more than 1,000 independent citations, and she has been principal investigator for seven grants at the university.

"My research is at the boundary between several disciplines, such as chemistry, physics, materials science and engineering," Wang said. "I hope to establish large-scale collaborations with faculty in these departments, and I would like to see my work make significant contributions to the growth and evolution of materials and energy-related research at LSU."

Being named an LSU Rainmaker is "particularly encouraging to junior faculty and female faculty like me," Wang said. "I believe new materials design and synthesis are very important to developments of next-generation energy technologies, which in turn will widely impact the economy in the state and the country."

Slack and Wang were each awarded a one-time stipend of $1,000 and a plaque in recognition of their achievements.

Mid-Career Scholar Award

This award recognizes faculty members at the associate professor level, or recently promoted to full professor, who exhibits a sustained program of excellence, has between eight to 15 years of research or creative activities and scholarship and has strong name recognition in his or her field.

This year's recipient is **Milen Yakimov**, professor of mathematics. Yakimov's research in noncommutative algebra studies the structure and geometric and algebraic properties of noncommutative rings. Yakimov has settled various well-known open mathematical problems throughout his career, and one of his most recent accomplishments is finding proof for the long-standing Andruskiewitsch-Dumas conjecture. He is currently working on another conjecture which, if proven, will lead to a third large family of catenary algebras.

"Algebra is one of the main areas of pure mathematics," Yakimov said. "I hope my research will increase the presence of our university in this area, both in terms of educating graduate and undergraduate students and in research accomplishments."

He said being named an LSU Rainmaker was a tremendous honor and "a great motivation to work more and to attempt harder problems."

Yakimov received a one-time stipend of $1,000 and a plaque recognizing his achievements.

Senior Scholar Award

This award recognizes faculty members whose work is comparable to the quality of that considered for the Distinguished Research Master award or Boyd Professor designation. The Senior Scholar Award is typically reserved for faculty members who have been promoted to full professor and has exhibited a sustained program of excellence as measured by significant contributions to the faculty member's field of research or creative activity for 15 or more years.

This year's Senior Scholars are:

James Honeycutt, professor of communication studies, who received the Senior Scholar Award in Arts, Humanities and Social or Behavioral Sciences. Honeycutt's research, which focuses on social cognition, imagined interactions and relational communication, involves interdisciplinary applications in communication, psychology and family studies. His major career accomplishments include creating the Imagined Interaction Theory, forming an imagined interaction research program and the Matchbox Interaction Lab at LSU and delivering a keynote address at Yale University for the American Association for the Study of Mental Imagery.

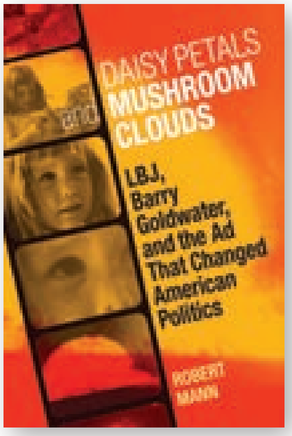
"Being named an LSU Rainmaker Senior Scholar is memorable," Honeycutt said. "LSU is the flagship university of the state, and I am very proud to be part of 'The Louisiana State University.'"

Jacqueline Stephens, professor of biological sciences, who received the Senior Scholar Award in Science, Technology, Engineering and Mathematics. Stephens' research program studies adipocyte cells and obesity's role in the development of type 2 diabetes. Stephens, who is also the Claude B. Pennington Jr. Endowed Chair in Biomedical Research at the Pennington Biomedical Research Center, has been an invited speaker at Harvard Medical School and the University of Chicago Kovler Diabetes Center, and her recent work has been published in various academic journals, including *Trends in Endocrinology and Metabolism*.

"It is a joy to get an award like the Rainmaker from LSU," Stephens said. "It is always a great feeling when you are recognized at your own university and know you have the support of your colleagues."

Honeycutt and Stephens were each awarded a one-time stipend of $1,000 and a plaque in recognition of their achievements.

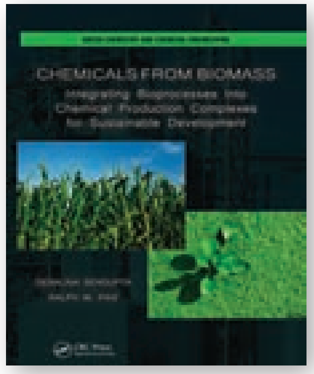
Media Shelf



Daisy Petals and Mushroom Clouds: LBJ, Goldwater and the Ad that Changed American Politics

Robert Mann, Manship Chair in Mass Communication and director of the Reilly Center for Media & Public Affairs

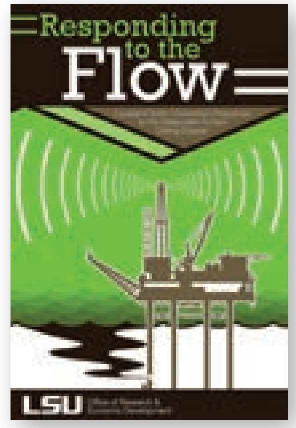
Mann's book explores the historical context and long-term impacts of Lyndon B. Johnson's controversial, iconic and successful political ad that, when launched against Barry Goldwater in the 1964 presidential election, sparked a new era in the relationship between politics and advertising.



Chemicals from Biomass: Integrating Bioprocesses into Chemical Production Complexes for Sustainable Development

Debalina Sengupta, Ph.D., LSU Cain Department of Chemical Engineering; and Ralph W. Pike, Paul M. Horton Professor of Chemical Engineering and director of LSU's Minerals Processing Research Institute

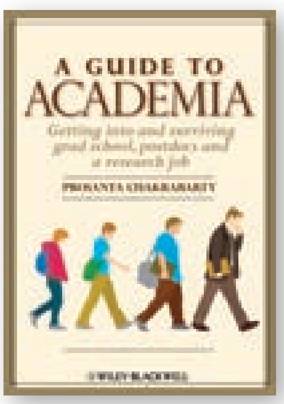
This text, based on Sengupta's dissertation in chemical engineering at LSU, details aspects of bioprocess engineering involved in the production of chemicals from renewable resources and from biomass, or biological material from living or recently living organisms. The book helps engineers optimize the development of new chemical and polymer plants that use renewable resources to replace the output of goods and services from existing plants and discusses the conversion of existing plants into facilities based on renewable resources.



Responding to the Flow: Louisiana State University's Response to the Deepwater Horizon Drilling Disaster

Ashley Berthelot, director of LSU Research Communications and adjunct professor of mass communication; Matthew R. Lee, associate vice chancellor of research and economic development and professor of sociology; and Holly Carruth, coordinator at LSU's Office of Research & Economic Development

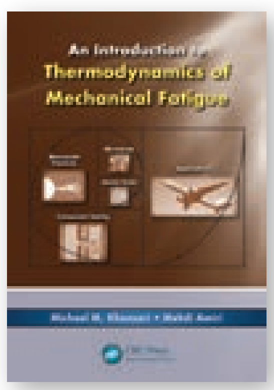
This publication from LSU recounts how the university's researchers, faculty and staff from various departments across campus came together in the aftermath of the worst technological disaster in American history, offering their services to Louisiana and the Gulf Coast in the form of research and community outreach.



A Guide to Academia: Getting into and Surviving Grad School, Post Docs and a Research Job

Prosanta Chakrabarty, assistant professor of ichthyology at LSU's College of Science

Chakrabarty's guide gives practical insight and advice to students interested in pursuing careers in academia, highlighting aspects of the process such as applying for graduate school and postdoctoral positions, designing courses to teach and composing grant proposals and research publications.



Introduction to Thermodynamics of Mechanical Fatigue

Michael M. Khonsari, Dow Chemical Endowed Chair in Rotating Machinery and professor of mechanical engineering, and Mehdi Amiri, mechanical engineering graduate student

Khonsari and Amiri's text gives an overview of the different ways materials degrade, with particular emphasis on thermodynamics' effect on the process and methods engineers can apply in the design stage to counteract the problem.

The Vulgar Question of Money: Heiresses, Materialism, and the Novel of Manners from Jane Austen to Henry James

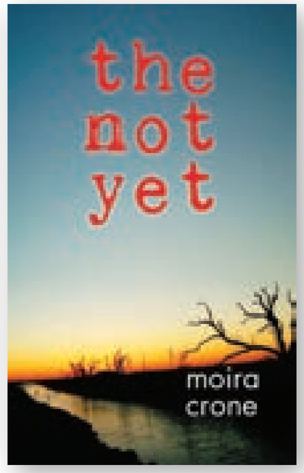
Elsie Michie, associate professor of English

"The Vulgar Question of Money" explores how fictional female characters represent the correlation between wealth and integrity in 19th-century novels, such as Pride and Prejudice, and how this relationship evolves in literature with the development of capitalism in British society.

Landscape Architecture and New Orleans: Room for Only One?

Max Z. Conrad, professor of landscape architecture

Conrad's memoir traces the history of LSU's Robert S. Reich School of Landscape Architecture, from its birth in the 1950s, when Conrad was one of Reich's first students, to the school's current status as one of the nation's top-ranked landscape architecture programs.



The Not Yet

Moira Crone, professor emerita of English

Crone's science fiction novel, a coming-of-age story set in the dystopian future of 22nd-century New Orleans, explores modern-day, real-life social issues such as class inequality, reproductive rights and mankind's quest for immortality.

Floating Souls: The Canal Murders

Mary H. Manhein, director of the LSU FACES laboratory

Manhein draws from nearly 30 years of experience in forensic anthropology in her first fiction novel, a murder mystery that brings the book's heroine from New Orleans, Louisiana to Venice, Italy to catch a killer and solve an ancient enigma.

The Phaidon Archive of Graphic Design

Richard Doubleday, assistant professor of art

Doubleday is a contributing author for this collection of 500 international graphic designs representing a range of time periods and media, from 15th-century newspapers to modern-day CD covers, presented in a "book-in-a-box" format that can be organized alphabetically, chronologically, by category or by designer.

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The Louisiana Digital Media Center

The burgeoning industries of entertainment and technology will converge and academic achievement will meet economic development at LSU's new Louisiana Digital Media Center, or LDMC, scheduled to open late in 2012. Located near the south gates of campus as a sister structure to the Louisiana Emerging Technology Center, the LDMC will encompass three stories and 100,000 square feet. It will be the new home for LSU's Center for Computation & Technology, or CCT, and Electronic Arts', or EA's, North American Testing Center. The $29.3 million facility is a joint initiative from the LSU Research & Technology Foundation, the Louisiana Department of Economic Development and the U.S. Economic Development Administration.

To view a live construction feed of the LDMC, visit http://www.laetc.com/louisiana-digital-media-center/.