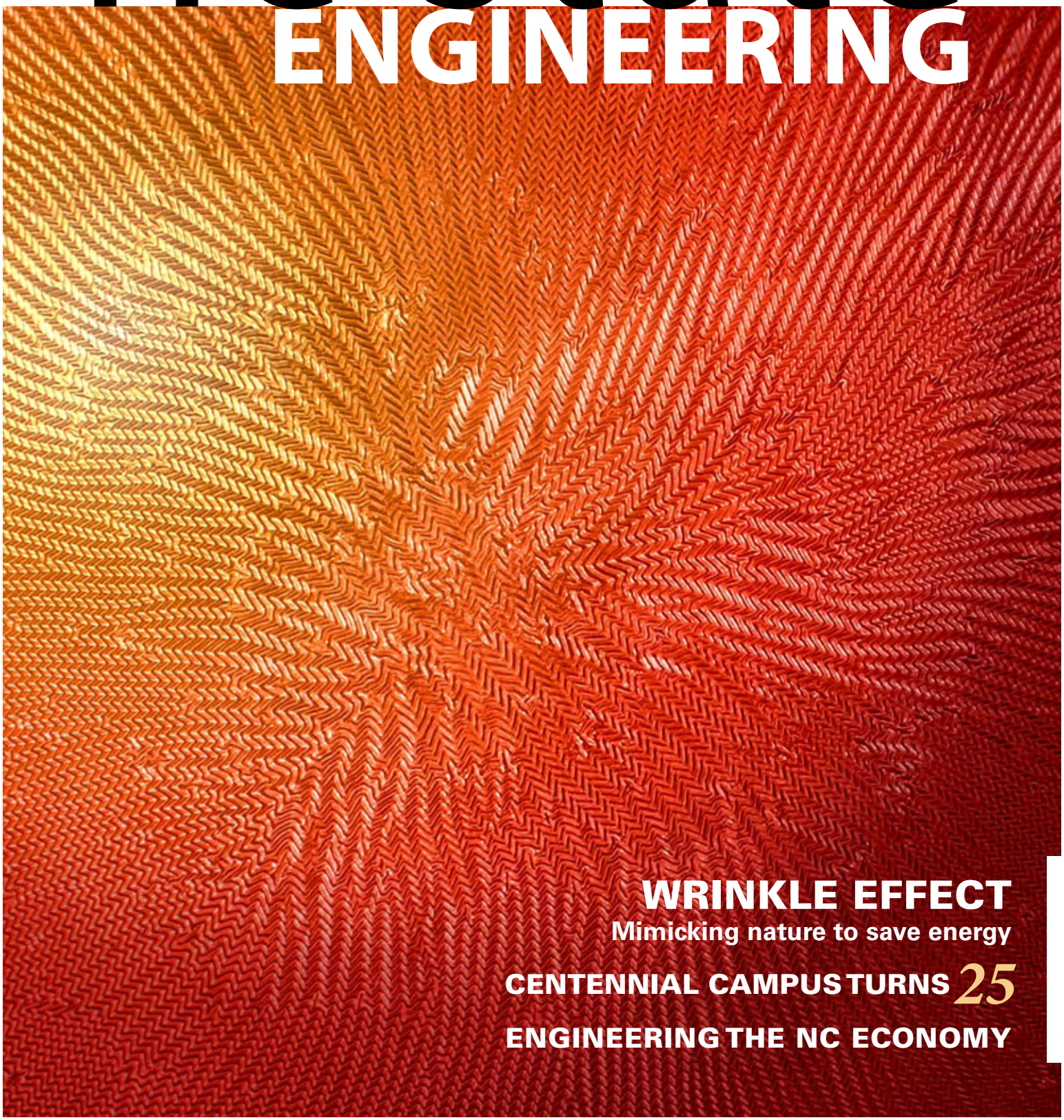
NC STATE UNIVERSITY

FALL 2009

nc state ENGINEERING



WRINKLE EFFECT

Mimicking nature to save energy

CENTENNIAL CAMPUS TURNS 25

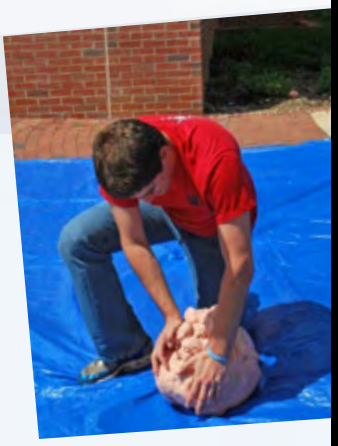
ENGINEERING THE NC ECONOMY

DROPPING THE BALL

What happens when you drop a 50-pound ball of Silly Putty off the D.H. Hill Library roof? Will it bounce or break?

It will break—into about a million little pieces.

The drop was part of the Materials Science and Engineering summer camp, one of several camps held at NC State each year for elementary, middle and high school students. The idea behind the ball drop was to learn how materials react under strain. Smaller balls dropped off the roof bounced on the Brickyard, but the 50-pounder—let's just say cleanup was required.



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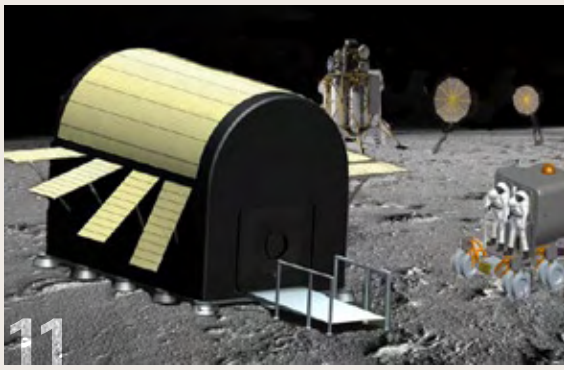
DEPARTMENTS



ON THE COVER: Buckling patterns are formed by stretching materials, exposing them to an ultra-violet ozone treatment and then releasing the tension. NC State engineers found that these "wrinkles" helped prevent barnacles from gripping the materials, an important development that can save ship owners fuel and money.

OFFICE OF THE DEAN

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CHANGE OF ADDRESS?

Alumni, you can update your contact information online at **http://www.alumniconnections.com/olc/pub/NCS/** or send address corrections by email to **alumnianddonor_records@ncsu.edu.** You can also send changes to the NC State Engineering Foundation Inc. at the address above, or call 919.515.7458, toll free: 866.316.4057.

Did you know?

Did you know that the Gorilla Goal, a popular basketball goal, was invented by an NC State mechanical engineering professor and alumnus? Dr. Frank Hart (BS '59, MS '61, PhD '65) developed the new goal in the early 1980s as slam dunkers continued to shatter glass backboards and bend collapsible rims. Hart and his team conducted the first definitive research on how stress affects the rim and backboard, which led to the development of the new goal.

FROM THE DEAN

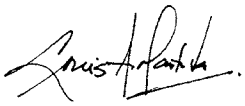
Louis A. Martin-Vega

The many challenges that NC State has faced over the past few months have tested our university and college perhaps more than ever before. However, I am pleased to report that under the steady hand of our new chancellor, Dr. James Woodward, we continue to enjoy great success and are excited about the future. We remain committed to our core mission of discovery, learning and innovation, all in service to the economic development of North Carolina and our nation's competitiveness.

This fall our college welcomed 1,391 new freshmen, making our total enrollment more than 8,000 of the best and brightest engineering and computer science students in the nation. Thanks to the efforts of our outstanding faculty and staff we have seen a substantial increase in the number of research awards and are estimating a record $130 million in total research expenditures for 2008–09. We have hired 14 new faculty members, including three new department heads, one of whom is our first female department head, Dr. Nancy Allbritton. This represents an important milestone for our college.

The following pages detail many more examples of our success. You will meet Dr. Kara Peters, whose work helped bring Spirit AeroSystems to North Carolina, and Fred Gant, an alumnus who is helping NC State researchers bring a promising new drug to market. You can read about how "wrinkles" will save fuel and reduce down-time for ships and how students developed a better way to test for tuberculosis. We also celebrate the 25th anniversary of the NC State Centennial Campus and explore how the College influences the economy across the state.

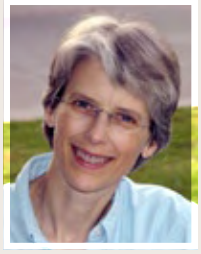
We are grateful for your continued support and look forward to the opportunities the coming year holds for our college—*your college*—to improve lives, educate students, conduct research and reach out to North Carolinians. I sincerely hope that you enjoy this redesigned *NC State Engineering* magazine, and I look forward to a continued dialogue with you on our shared future.



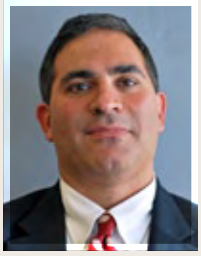
Louis A. Martin-Vega, Dean

The College welcomes three new department heads

The College of Engineering welcomes three new department heads. Dr. Nancy Allbritton, Dr. Justin Schwartz and Dr. Daniel Stancil joined the NC State faculty in August.



Nancy Allbritton



Justin Schwartz

Daniel Stancil

Allbritton has been selected to serve as head of the joint UNC-NC State Department of Biomedical Engineering. She replaces Dr. Troy Nagle, who was the founding chair of the department. Allbritton has served as the Paul Debreczeny Distinguished Professor at UNC-Chapel Hill since 2007. She received her Ph.D. in medical physics/medical engineering from MIT and her M.D. from Johns Hopkins University.

Schwartz has been named head of the Department of Materials Science and Engineering. He replaces Dr. Michael Rigsbee, who had led the department since 1998. Schwartz will also hold the Kobe Steel Distinguished Professorship at NC State. He comes to NC State from Florida State University, where he held the Jack E. Crow Professorship. He received his Ph.D. in nuclear engineering from MIT.

Stancil is the new head of the Department of Electrical and Computer Engineering. He replaces Dr. Robert Kolbas, who had served as interim department head since 2008. Stancil will also hold the Alcoa Distinguished Professorship at NC State. He comes to NC State from Carnegie Mellon University, where he served on the faculty and also held appointments as associate department head and associate dean. He received his Ph.D. in electrical engineering from MIT. ▪

Q & A

Questions for KARA PETERS

Dr. Kara Peters, associate professor of aerospace engineering, designs and studies sensors that are built into space-age airplane components, work that puts her on the cutting edge of modern aircraft design. She talks about her research, her students and her work on bringing a major aerospace manufacturer to North Carolina.

Your research deals with composite structures found in airplanes. How are these different from traditional aircraft materials? More and more, aircraft manufacturers such as Boeing and Airbus are using composite components such as carbon fiber and graphite fiber reinforced epoxies and others in their designs. Composites are lighter than traditional aluminum-type materials, which means the plane uses less fuel.

You also design sensors that monitor these composites during flight. Why are these sensors needed? Composites have their strengths, but they also present a different set of challenges. For example, if a maintenance person drops a hammer on an aluminum wing, it's going to visibly damage the wing. With composites, however, the damage will first occur on the interior and won't be immediately visible. And since composite materials are made of several different constituents, it's more difficult to predict when those materials will fail as they age. My work focuses on using optical fibers and sensors built into the aircraft that monitor those materials during flight and send information about them to people in the cockpit and on the ground.

NC State helped bring Spirit AeroSystems to Kinston, NC. How were you involved in this? Spirit came to NC State for a day when the state was negotiating with them, and there were several of us who gave presentations and talked to them while they were here. It's great news that they're coming here.

Why is the Spirit announcement so important for your work? The strongest impact is on the students. The facility won't open until next year, but my undergraduates are already talking about it. They'll be able to visit a large-scale composites manufacturing center and see that great jobs are available right here in North Carolina for people doing this work.

You left Lausanne, Switzerland, where you did your post-doc work, to come here. What attracted you to NC State? The job really fit what I wanted to do, and there was this general enthusiasm here. Out of the various places where I interviewed, NC State was by far the strongest in terms of people really liking where they worked.

You've been here nine years now. Would you say they were right? Absolutely. Dean Martin-Vega has brought a burst of energy, and people are excited about that. There's much more talk about becoming the nation's top public engineering school and what we need to do to get there. And I think that has a tremendous impact on people's enthusiasm and the work they do.

Above: *New York Times* columnist David Brooks was at NC State in February to speak at the University's Emerging Issues Forum, and he took some time to drop by the NSF FREEDM Systems Center. Brooks, second from left, visited with students and took a tour of the smart-grid center.

Left: The Golden LEAF BTEC was featured in the *Economist*.

NC State engineering continues to draw attention from well-known national and international media.

In April, for example, the *Economist* featured the role of the **Golden LEAF Biomanufacturing Training and Education Center (BTEC)** in North Carolina's burgeoning biotechnology sector. The London-based magazine is one of the world's leading news and business publications.

The story noted that North Carolina has invested more than $1.2 billion in biotechnology over the past 10 years for facilities, research, training programs and incentives for companies. A big part of that is BTEC, housed in a new building on Centennial Campus that is the largest facility of its kind in the nation. The story mentioned North Carolina's role in reaching out to industry and training biomanufacturing workers, adding that BTEC was an even "more elaborate example of college-state-industry interaction."

BTEC's building was paid for from the state's 1998 settlement with tobacco companies, the story notes, and its operating costs are covered by the state. The center trains as many as 2,000 people each year for biomanufacturing jobs.

"We look at ourselves, and I think the state does too, as an economic-development tool," Rick Lawless, the associate director of the center, told the magazine.

Also getting media attention is the **NSF FREEDM Systems Center,** formed in 2008 by an $18.5 million Engineering Research Center grant from the National Science Foundation.

The center, also headquartered on Centennial Campus, is finding new ways to build an "Energy Internet" that speeds renewable energy via smart grid into millions of homes and businesses. When veteran Associated Press energy writer H. Josef Hebert was looking for experts to describe the meters that will monitor energy use on the smart grid, he asked Dr. Alex Huang, the center's director.

"The meter is only the beginning," Huang told him. Huang went on to say that instead of power flowing from a small number of power plants, the smart grid can usher in a system of distributed energy so electricity "will flow from homes and businesses into the grid, neighborhoods will use local power and not just power flowing from a single source."

The story was picked up by newspapers and websites all over the country, including *USA Today,* MSNBC, *Forbes* and the *Boston Globe.* ▪

Dodging the Big One

If death by asteroid is not foremost among your concerns, consider this: NASA's Near Earth Object Program has identified more than 1,000 "potentially hazardous asteroids" in space. Officials are finding more all the time.

David French is just a normal guy doing his part to save the planet from total annihilation.

French, a doctoral candidate in aerospace engineering, has figured out a way to effectively divert asteroids and other threatening objects from hitting Earth by attaching a long tether and ballast to the incoming object. By attaching the ballast, French explained, "you can change the object's center of mass, effectively changing the object's orbit and allowing it to pass by the Earth, rather than impacting it."

If death by asteroid is not foremost among your concerns, consider this: NASA's Near Earth Object Program has identified more than 1,000 "potentially hazardous asteroids" in space. Officials are finding more all the time.

"While none of these objects is currently projected to hit Earth in the near future, slight changes in the orbits of these bodies,

which would be caused by the gravitational pull of other objects, push from the solar wind or some other effect, could cause an intersection," French explained.

So French, along with Dr. Andre Mazzoleni, associate professor of mechanical and aerospace engineering, studied whether an asteroid-tether-ballast system could effectively alter the motion of an asteroid to prevent a collision with Earth. The answer? Yes.

While using a tether somewhere between 1,000 and 100,000 kilometers might sound extreme, French said, look at the alternatives. Other plans call for painting the asteroids in order to alter how light may influence their orbit, guiding a second asteroid into the threatening one, and blasting the asteroid with nuclear weapons.

"Compare it to other schemes," French said. "They are all pretty far out." ▪

Creating energy from…duckweed?

Call it the little plant that could.

Researchers at NC State have found that duckweed—a tiny aquatic plant—can be used to clean up animal waste at industrial hog farms and potentially be part of the answer for the global energy crisis.

Their research shows that growing duckweed on hog wastewater can produce five to six times more starch per acre than corn, according to Dr. Jay Cheng, professor of biological and agricultural engineering. This means that ethanol production using duckweed could be "faster and cheaper than from corn," said fellow researcher Dr. Anne-Marie Stomp, associate professor of forestry.

Corn is currently the primary crop used for ethanol production in the United States. But duckweed presents an attractive, non-food alternative that has the potential to produce significantly more ethanol feedstock per acre than corn, can exploit existing corn-based ethanol production processes for faster scale-up and can turn pollutants into a fuel production system.

The duckweed system consists of shallow ponds that can be built on land unsuitable for conventional crops and is so efficient it generates water clean enough for re-use. The technology can utilize any nutrient-rich wastewater, from livestock production to municipal wastewater. Post-doctoral research associate Mike Yablonski also worked on the research.

"In the spirit of George Washington Carver, who turned peanuts into a major crop, Jay and I are on a mission to turn duckweed into a new industrial crop providing an innovative approach to alternative fuel production," Stomp said. ▪

The beat goes on

When researchers test new tools and techniques for heart surgery, they usually turn to live pigs, which have heart valves that are anatomically similar to those found in humans. Problem is, researchers tend to spend lots of time and money on those animal or clinical trials.

Engineers at NC State are trying to cut those costs. They have developed a new machine that pumps fluid through a pig heart in a realistic way, creating a quick and inexpensive testing method.

"Researchers can obtain pig hearts from a pork processing facility and use the system to test their prototypes or practice new surgical procedures," said Andrew Richards, a Ph.D. student in mechanical engineering who designed the heart machine.

The computer-controlled machine, which operates using pressurized saline solution, also allows researchers to film the interior workings of the pumping heart—enabling them to ascertain which surgical technologies and techniques perform best for repairing heart valves.

Because this "dynamic heart system" does not involve living pigs, researchers can avoid the lengthy permission processes associated with live animal testing.

"There will still be a need for testing in live animal models," said Dr. Greg Buckner, associate professor of mechanical and aerospace engineering and director of the project, "but this system creates an intermediate stage of testing that did not exist before. It allows researchers to do 'proof of concept' evaluations, and refine the designs, before operating on live animals."

The new system also promises to save researchers lots of money.

"It costs approximately $25 to run an experiment on the machine," Richards said, "whereas a similar experiment using a live animal costs approximately $2,500." ▪

A star for service

Rocket attacks. Kidnapping threats. Suicide bombers.

Life was not easy for Dr. John Muth during his recent tour of duty as a U.S. Navy reservist in Iraq. For 12 months, the associate professor of electrical and computer engineering led a team of 30

civilians, military personnel and translators in providing advice and support to Iraq's Ministry of the Interior.

For his efforts, Muth received a Bronze Star, an honor rarely awarded to Naval officers because relatively few of them have been assigned to combat zones in Iraq. Muth's service included performing more than 100 missions, installing a system of human rights inspections at pre-trial detention centers and setting up the ministry's court systems.

But the dangers of Iraq were never far from his mind.

"There is a lot of assassination, murder and kidnapping that can be either ideologically or financially motivated," Muth said. "A lot of the people I worked with were specifically targeted by insurgents. The courage of the Iraqis I worked with who were trying to improve their country was impressive."

Nevertheless, Muth was able to keep up with the work of his students, participating in six defenses of master's theses and doctoral dissertations during various breaks from his tour. He also reviewed papers bound for scientific journals.

> "The **courage** of the Iraqis I worked with who were trying to improve their country was **impressive.**"

Since returning to Raleigh, Muth has resumed his teaching and research in nanoelectronics and photonics, for which he has received awards from the National Academy of Engineering, the Office of Naval Research and other agencies. He holds six patents and has more than 90 journal publications to his credit.

"I enjoy the intellectual challenges of the university and the academic freedom to research subjects I choose," Muth said. ▪

Fighting TB as easy as 1-2-3

> We decided that we had to create something so that you could push a button and read the test results. **It had to be that simple.**

Tuberculosis is one of the world's most intractable medical problems, spreading at the alarming rate of one new infection every four seconds. It has now infected up to one-third of the people on Earth, primarily in the developing world, where diagnostic and treatment tools are scarce.

And it's an effective killer, claiming 1.7 million lives each year.

But those numbers may change thanks to the pioneering work of three NC State undergraduates who have developed the first practical diagnostic device for TB that is cheap, fast and accurate.

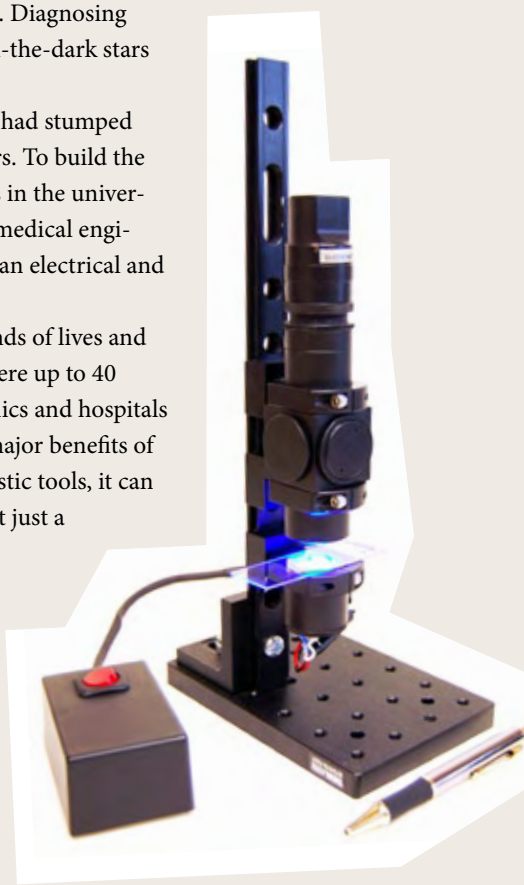
"Here's the simple explanation," said Daniel Jeck, a biomedical engineering student. "You take a patient's saliva and put it on a slide. Then you place the slide in our device. If it glows green, then the patient has an active case of TB. Diagnosing tuberculosis is now as easy as counting glow-in-the-dark stars on the ceiling."

The explanation might sound simple, but it had stumped professional medical device developers for years. To build the device, Jeck teamed up with two other students in the university's Engineering Entrepreneurs Program: biomedical engineering major Pavak Shah and Hersh Tapadia, an electrical and computer engineering major.

The device has the potential to save thousands of lives and millions of dollars in the developing world, where up to 40 percent of all active TB cases are missed by clinics and hospitals using traditional diagnostic tools. One of the major benefits of the device is that, unlike the traditional diagnostic tools, it can be used by anyone who can use a computer, not just a trained professional.

The students are still investigating options for the distribution of their device, which they estimate could be mass-produced for under $500 each.

"We decided that we had to create something so that you could push a button and read the test results," Tapadia said. "It had to be that simple." ▪



Standing tall

NC State engineering students built a bridge in downtown Raleigh—in one day.

A group of students had just one day to build a fully functional temporary pedestrian bridge outside the Legislative Building in Raleigh.

They did it.

Students from several engineering departments worked all day April 21 to erect the bridge and spent the following day giving tours and answering questions from legislators about its construction. Seniors Lina Lawrence, Matthew Poisel, and Ahmad Saffouri of the Department of Civil, Construction, and Environmental Engineering led the bridge design, which won them the 2009 Future of Engineering Award from the American Council of Engineering Companies of North Carolina (ACEC/NC).

The students were also recognized for their work by Sen. Tony Rand in the NC Senate Chambers.

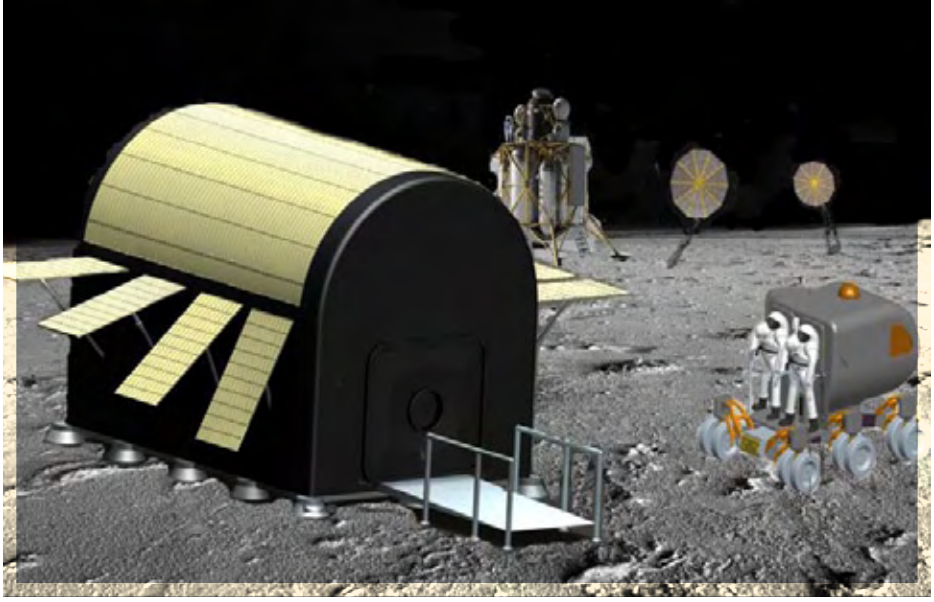
The student-built bridge was no small structure. The walkway from one side to the other spanned 50 feet, and its arches reached 20 feet high. The bridge also featured an LED lighting system, an LED clock and data collection systems, all powered by on-bridge solar panels. Eleven students from the departments of industrial and systems engineering, electrical and computer engineering, computer science and materials science and engineering were part of the bridge team.

Students built the bridge after winning a competition that required teams to design a temporary pedestrian bridge suitable for quick deployment in remote areas.

The bridge was taken down after the competition, but officials plan to rebuild it on Centennial Campus.

The bridge construction occurred as part of Engineering Days, a biennial event held by the engineering companies of ACEC/NC to highlight the leadership role that engineering plays in the present and future prosperity of North Carolina. ▪

Watch a time-lapse video of the bridge construction at: **www.engr.ncsu.edu/magazine**.



More "Star Trek" than "Snuggie"

With NASA's plans to return to the moon by 2020 and station astronauts for several months, concern has grown over a dangerous phenomenon—space radiation. When space rays hit matter, they produce a dangerous spray of secondary particles which, when penetrating human flesh, can damage DNA, boosting the risk of cancer and other maladies. All this means that NASA needs a way to protect the astronauts on the moon.

Enter the lunar "blanket."

Michael Sieber, Ryan Boyle and Anne Tomasevich, textile engineering students who graduated this spring, have developed a covering for lunar outposts—the astronauts' living quarters on the moon.

The "blanket" was chosen as one of 10 undergraduate finalists in the Revolutionary Aerospace Systems Concepts Academic Linkage competition, an event sponsored by NASA and the National Institute of Aerospace.

"The product needed to be as lightweight as possible to feasibly fit on the transportation module and have the ability to be easily erected by a minimum number of astronauts for immediate use once on the moon," Sieber said.

The "lunar texshield" is made from a lightweight polymer material that has a layer of radiation shielding that deflects or absorbs radiation. Its outermost surface includes a layer of solar cells to generate electricity, backed up by layers of radiation-absorbing materials.

"We used what we've learned throughout our college careers and were able to apply that logic to provide a solution to a real-world problem. That is what is cool to us." ▪

Engineering a greener NC State

What do industrial engineering and protecting the environment have in common? A whole lot, says senior Natasha Herting.

"Many industrial engineering concepts can be used to reduce waste, improve efficiency and reduce lead times," she said. "One could say that is being more sustainable."

Herting, who will graduate in December with a degree in industrial and systems engineering, has become something of a sustainability dynamo during her four years at NC State.

She wrote and helped pass the first Campus Sustainability Continuous Improvement Act as a member of the Student Senate, calculated the university's Greenhouse Gas Emissions Inventory for the new Office of Sustainability and is assisting in the implementation of PackPulse, a real-time energy monitoring system for two residence halls.

"Sustainability was always something that I was passionate about," she said.

Sustainability has many definitions, but one way to think about it is meeting present needs without compromising the abilities of future generations to meet their own needs.

Eventually, Herting wants to start her own sustainability consulting firm, helping companies identify areas where they can reduce waste and increase profits at the same time.

But first things first. Work remains on the sustainability improvement act, which needs endorsement from other campus groups before it takes full effect. Among its provisions is a commitment to providing sustainability-related coursework allowing students to receive credit for their projects.

Ideally, the University would permanently install these systems, so students would know their work would leave a legacy.

"If students have a significant connection to NC State, they're more likely to stay connected as alumni and continue to support the improvement of the university," Herting said. ▪

Energized

Researchers in the College of Engineering are receiving $5.9 million in new nuclear energy research funding from the U.S. Department of Energy, the most awarded to any university for nuclear research during the round of funding announced this spring.

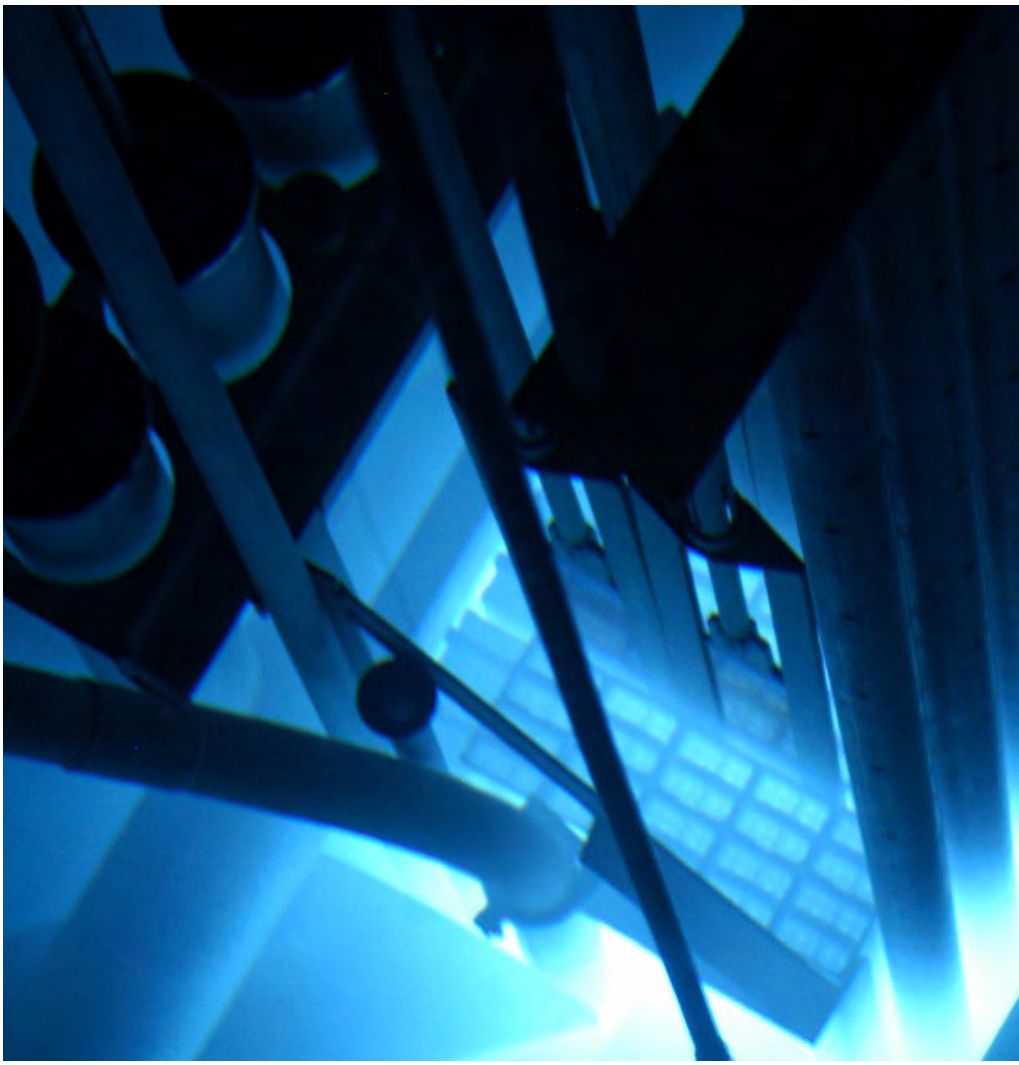
The seven awards to NC State were among 71 nuclear energy research awards announced in May by U.S. Energy Secretary Steven Chu. The NC State projects accounted for 13.5 percent of the total announced funding and are part of federal initiatives to improve nuclear energy production and management.

The research awards include funding related to nuclear power plant design, thermal neutron scattering and developing new algorithms for reactor physics calculations.

Nuclear research has been a cornerstone of NC State engineering since 1953, when the University began operating the nation's first public research nuclear reactor. The program is consistently listed among the top 10 in national rankings. The research awards include funding related to nuclear power plant design, thermal neutron scattering and developing new algorithms for reactor physics calculations.

Among the researchers receiving awards was Dr. Ayman Hawari, director of NC State's Nuclear Reactor Program, who received three awards totaling more than $3.2 million. Other faculty from the Department of Nuclear Engineering and the Department of Civil, Construction, and Environmental Engineering also received awards.

NC State will serve as the lead research institution on the seven projects, while other universities and national laboratories will serve as collaborators and research partners. ▪



Pattern recognition

A new tool developed by NC State computer scientists will help researchers identify the minute changes in DNA patterns that lead to cancer, Huntington's disease and a host of other genetic disorders.

The tool translates DNA sequences into graphic images, which allows researchers to distinguish genetic patterns more quickly and efficiently than was historically possible using computers. David Cox, a Ph.D. student in computer science, devised the "symbolic scatter plot" tool to provide a visual representation of a DNA sequence.

"The human visual system is more adept at identifying patterns, and differentiating between patterns, than existing computer programs such as those that try

to identify repetitions of DNA sequences," Cox explained.

In other words, the naked eye sees patterns better than computers can.

Finding patterns in a sequence of DNA is important because it can help researchers identify the minute genetic variations between subjects that suffer from a disease, such as cancer, and subjects that do not.

"Improved identification of relevant DNA sequences will hopefully expedite the development of successful treatment for a range of diseases by allowing researchers to focus on the components of DNA that are related to the disease and improving our understanding of the genetic mechanisms of these diseases," Cox said. "For example, what turns specific genes on and off?"

With this new tool, researchers may be closer to finding the answer. ▪

Bottomley wins Presidential Award

The White House announced in July that **Dr. Laura Bottomley,** director of the Engineering Place at NC State, has won a Presidential Award for Excellence in Science, Mathematics and Engineering Mentoring.

The award honors the crucial role that mentoring plays in the academic and personal development of students studying science or engineering and who belong to groups that are underrepresented in those fields. Bottomley was one of 22 individuals and organizations honored by President Barack Obama for excellence in mentoring. In addition to being honored at a ceremony at the White House this fall, recipients receive awards of $10,000 to advance their mentoring efforts.

As director of the Engineering Place, Bottomley helps bring engineering to life for thousands of students, teachers and parents across the state. She also directs NC State's Women in Engineering program, which works to boost the number of women engineers in academia and industry, and acts as a consultant to the N.C. Dept. of Public Instruction and Wake County Public Schools. ▪

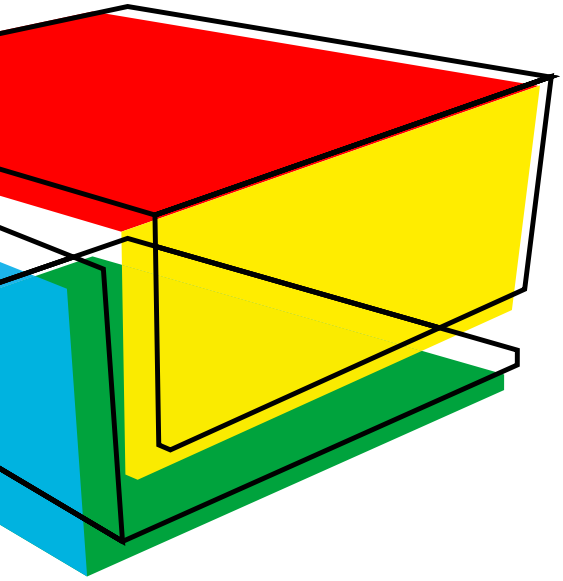
Zikry named Jefferson Science Fellow

Dr. Mohammed Zikry, professor of mechanical and aerospace engineering, was selected as a Jefferson Science Fellow by the U.S. Department of State.

Zikry was one of seven national science, technology and engineering experts chosen for the one-year assignment to advise the Secretary of State on issues related to science and technology. He began his one-year appointment in September 2008 and will continue to serve as a consultant to the department after completing his initial assignment.

"This an incredible opportunity to bring science and technology to the forefront, as far as the decisions that are made—decisions that can have a significant national and international impact," said Zikry, who has taught at NC State since 1990.

Zikry is a leading expert in computational modeling of systems, fracture mechanics, plasticity, functional nano and micro device design and experimental mechanics. ▪



THE ENGINEERING PLACE

A successful outreach program—*with a new name*—brings NC State engineering to life for students and teachers.

Emma Brody and Ponni Theetharappian, a couple of bright nine-year-olds on a field trip, were sitting under the picnic shelter, munching on sandwiches and discussing—what else?—solar panels.

"I learned that solar panels can be used for a lot of different things," Brody said of the day's earlier activities. "You can use them to heat your room."

"It's so easy to change the world without polluting," added Theetharappian.

Both students at Fuller Elementary School in Raleigh had spent the day learning about solar power as part of RAMP-UP, a program that brings NC State educators into elementary schools to teach kids about engineering, science, math and technology. On this day, the kids toured the NC State Solar House and visited the new solar farm at SAS Institute in nearby Cary, after which the kids settled down for lunch at the SAS picnic shelter.

RAMP-UP is just one of many programs that make up the Engineering Place, an outreach effort that aims to bring engineering to life for children and adults across North Carolina. Formerly called K-12 Engineering Outreach Programs, the Engineering Place is a unique program that reaches up to 10,000 undergraduates, graduate students and K-12 teachers statewide each year.

The goal: get more young people interested in engineering.

"We're making more of an effort to let people know the breadth and depth of our offerings," said Dr. Laura Bottomley, the Engineering Place director, "and one of the reasons to do that is that so many of the things that we do are linked with one another."

Why is all this important? Because the influence of technology on society is increasing quickly, and it's important for everyone to be able to understand how it works, Bottomley said. Furthermore, all that new technology has created a need for more engineers, including those who can bring forth new ideas to solve modern problems.

"We need different viewpoints," she said, "because to solve the types of problems that we're dealing with today, it's going to take a different mindset than the type of mindset that created those problems."

To do that, the Engineering Place has put together a unique collection of outreach programs. They include summer camps

Elementary school students in the RAMP-UP program listen as Jerry Williams of SAS Institute discusses the company's new solar farm. Below, the students visit the NC State Solar House.

for K-12 students; programs that send undergraduates and graduate students into schools to work with elementary schoolers; training sessions for NC State engineering alumni who want to be volunteer teachers in their communities; and assistance for teachers who want to introduce engineering concepts to their young students.

With all those programs, the Engineering Place could conceivably be part of a child's life from elementary school through graduate school. Students at Fuller Elementary, for example, can learn about engineering through the RAMP-UP program. When they get older, they can attend the middle- and high-school engineering camps at NC State. If those students attend NC State for college, they can help mentor K-12 students for four years—or even longer if they attend graduate school at NC State.

All the programs share a common goal of making engineering fun. In summer camps, the students build and race boats made of cardboard boxes; build brick walls and try to knock them down with golf balls; and drop balls of Silly Putty off an NC State library roof. Brody, Theetharappian and the other students in the RAMP-UP program got to check out an electric car.

These efforts, along with working closely with the College's Women in Engineering and Minority Engineering Programs, have boosted engineering's appeal among a broader group of students. African Americans, Native Americans and Latinos are traditionally underrepresented in the field, and women make up only about 20 percent of the undergraduate engineering population nationally.

But Bottomley has found that by running activities that research says appeal to those underrepresented groups, it benefits all students in the program.

"It turns out when you do those things, you make the program more appealing to everybody," Bottomley said.

The Engineering Place is unique among engineering outreach programs because it is integrated with the College's Office of Academic Affairs, which means that Engineering Place staff that work with K-12 students also interact with undergraduates and graduate students. That beneficial link results in older students mentoring younger students.

The program is also unique because of its partnerships. Its nationwide collaborators include the National Science Foundation and the National Academy of Engineering, and the program is also a testing ground for the Boston Museum of Science's "Engineering is Elementary" program. The Engineering Place also participates in a Wake-County-wide effort to change the way science and math are taught in public schools.

"There are lots of reasons to get more and different types of people interested in engineering," Bottomley said. "From there, it's just a short step to what we're doing at the Engineering Place."

More information at:
www.engr.ncsu.edu/theengineeringplace.

ENGINEERING *the* ECONOMY

Creating jobs. Inventing solutions. Improving lives.

During difficult economic times, NC State engineering continues to make its mark on North Carolina's economy.

1 MECHATRONICS — The joint NC State/UNC-Asheville mechatronics program integrates several engineering fields to improve design and production methods and create new information technology tools.

2 NUCLEAR ENGINEERING — NC State nuclear engineers are important partners with the state's two major utilities, Progress Energy and Duke Energy, and the growing energy-related industrial sector located in Charlotte, including companies such as Areva, Shaw Group and Fluor.

3 VIRTUAL COMPUTING LABORATORY— UNC-Greensboro is one of several campuses using NC State's Virtual Computing Lab to offer its students remote access to software that was previously only accessible in campus labs and offices. The VCL is expanding its reach to community colleges and K–12 schools.

4 INDUSTRIAL EXTENSION — When the Timken Company, a bearings manufacturer, wanted to improve its manufacturing process, it turned to NC State's Industrial Extension Service and saved nearly $900,000 in just a few months. IES is working to create $1 billion in economic impact in North Carolina by 2010.

5 GAME TIME — The Triangle is home to more than 30 video gaming companies, making it one of the nation's top game-development centers. Fueling this growth is the Digital Games Research Center, where NC State computer scientists collaborate with industrial designers and others to explore ways games can help people.

6 RESEARCH TRIANGLE PARK — Computer giant IBM employs more engineering graduates from NC State than from any other institution. Many work in Research Triangle Park.

7 ENGINEERING ENTREPRENEURS — The founder of Morrisville-based ChannelAdvisor Corp. is engineering alumnus Scot Wingo, who credits the Engineering Entrepreneurs Program at NC State for his business success. The program provides students with a full-immersion educational environment for prototyping new products and businesses.

8 NC SOLAR CENTER — With the state mandating that energy utilities produce more renewable energy by 2021, the NC Solar Center is helping to meet the goal. The Solar Center, which is part of the College, collaborated with SAS Institute in Cary on a solar farm that will help power the company's headquarters.

9 HOSPITAL HELP — Senior biomedical engineering students work with doctors at WakeMed Health & Hospitals in Raleigh to find problems in various clinical settings and then develop solutions. "They're coming in with new and innovative minds," a WakeMed official said.

10 SUPERSTREETS — NC State engineers have been leaders in promoting and designing "superstreets," intersections that employ U-turns to keep traffic moving smoothly and safely. The summer of 2009 saw NC State civil engineers conducting traffic studies on three superstreets in the Wilmington area.

11 SPIRIT AEROSYSTEMS — When Spirit AeroSystems was looking to build a new manufacturing plant, NC State engineering faculty worked with the Department of Commerce to help bring the company to Kinston. The new plant is scheduled to open next year and will eventually create more than 1,000 jobs.

12 NAVY PARTNERSHIP — The U.S. Navy base in Cherry Point turned to NC State's Institute for Maintenance Science and Technology to custom manufacture parts for older helicopters. These advanced techniques are creating skilled jobs that aren't easily lost to foreign competition.

13 DISTANCE EDUCATION — The College offers a 2+2 program as well as a four-year B.S. degree program with Craven Community College. These programs allow area residents, including military personnel, to pursue engineering degrees in Havelock for the first two years, and then transfer to NC State for the last two years.

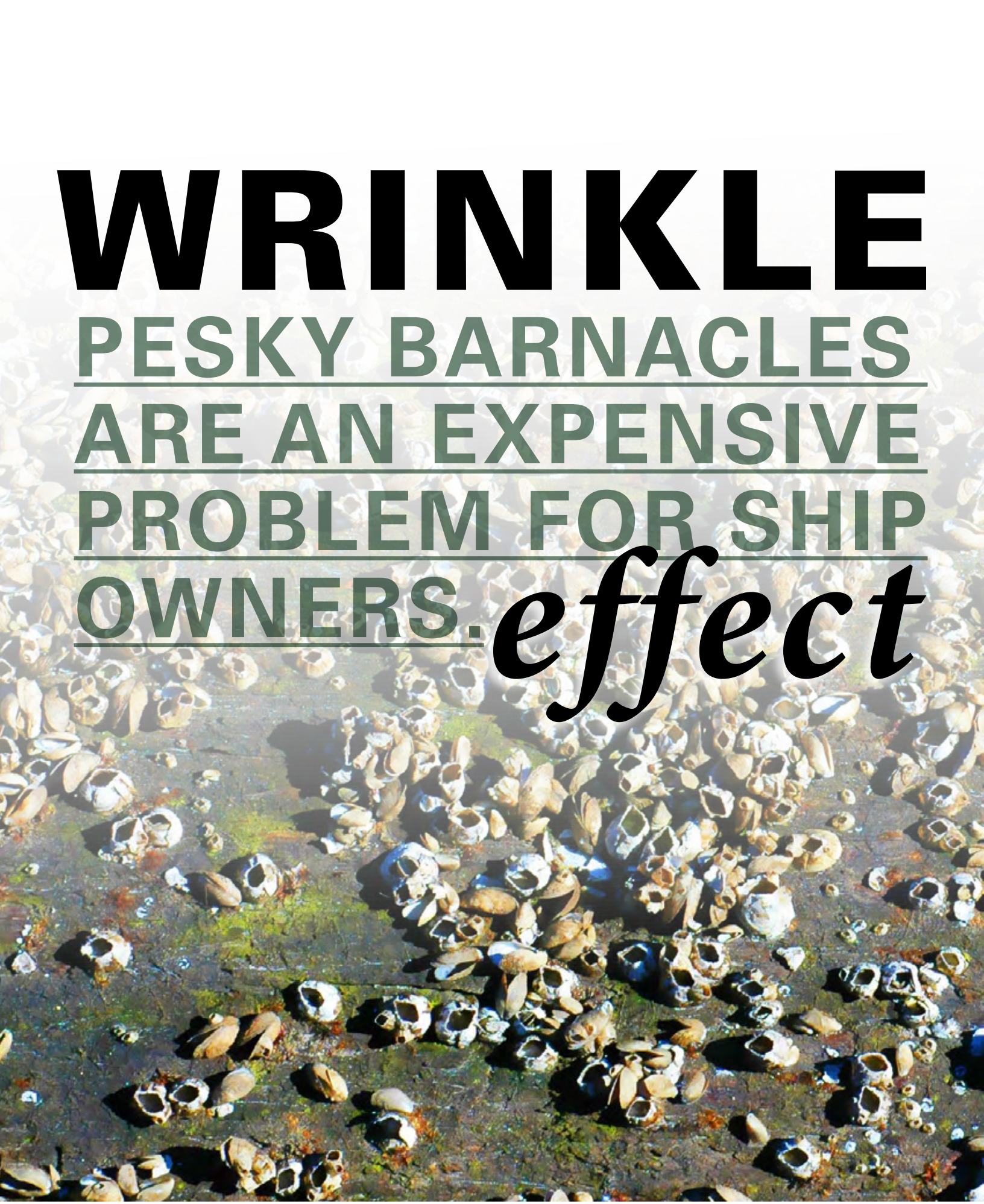
14 COASTAL RESEARCH — Coastal communities have always been subjected to waves and wind, and now they're coping with the effects of climate change. NC State's new program in Coastal Sustainability and Resilience, based in Manteo, uses engineering principles to develop solutions to coastal infrastructure challenges.


VIRGINIA
SOUTH CAROLINA
9
6
7
3
5
8
14
Greensboro
Research Triangle Park
Manteo
4
Morrisville
Cary
RALEIGH
Asheboro
11
2
12
Kinston
13
Charlotte
Cherry Point
Havelock
10
Wilmington

WRINKLE

PESKY BARNACLES ARE AN EXPENSIVE PROBLEM FOR SHIP OWNERS.

effect

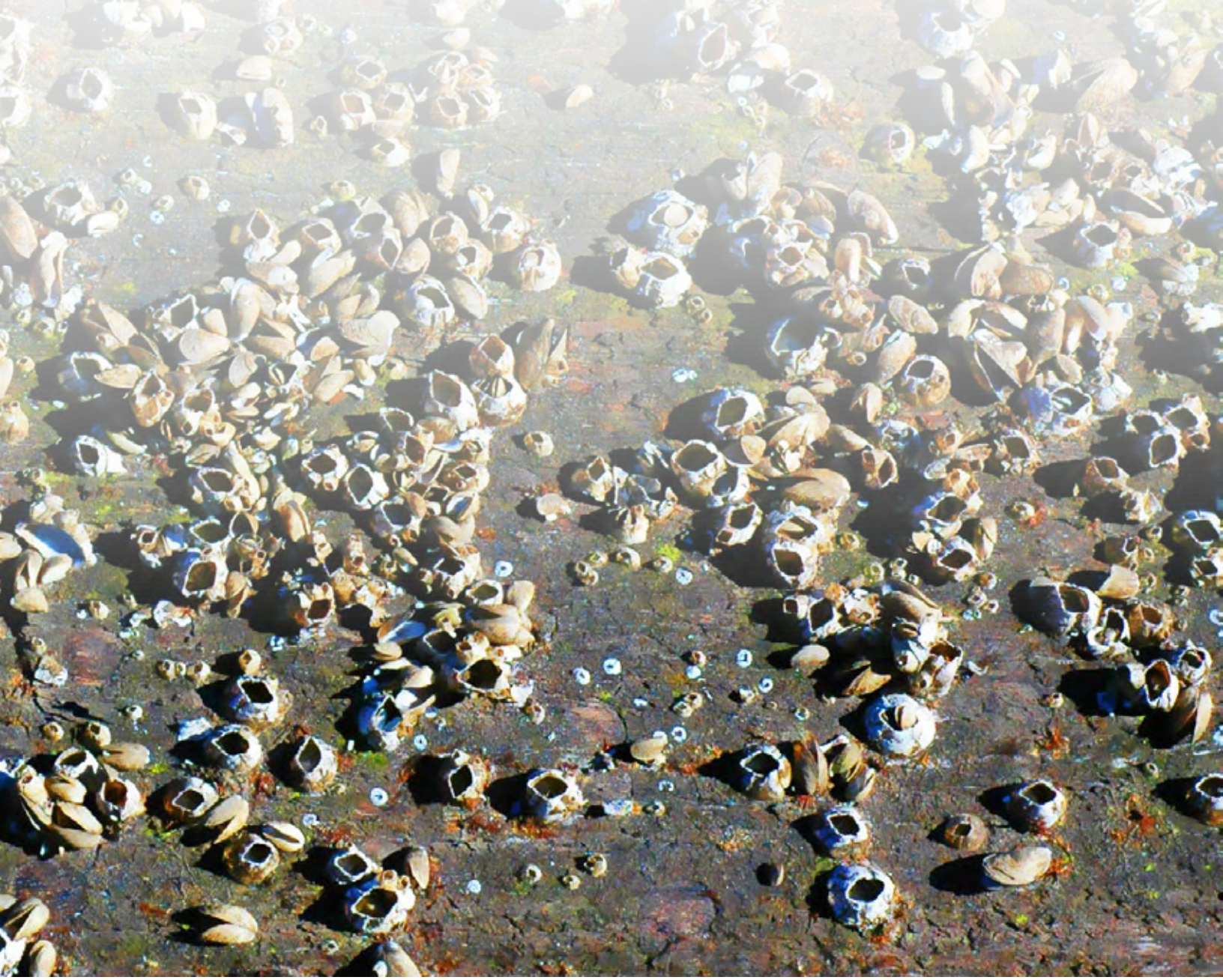


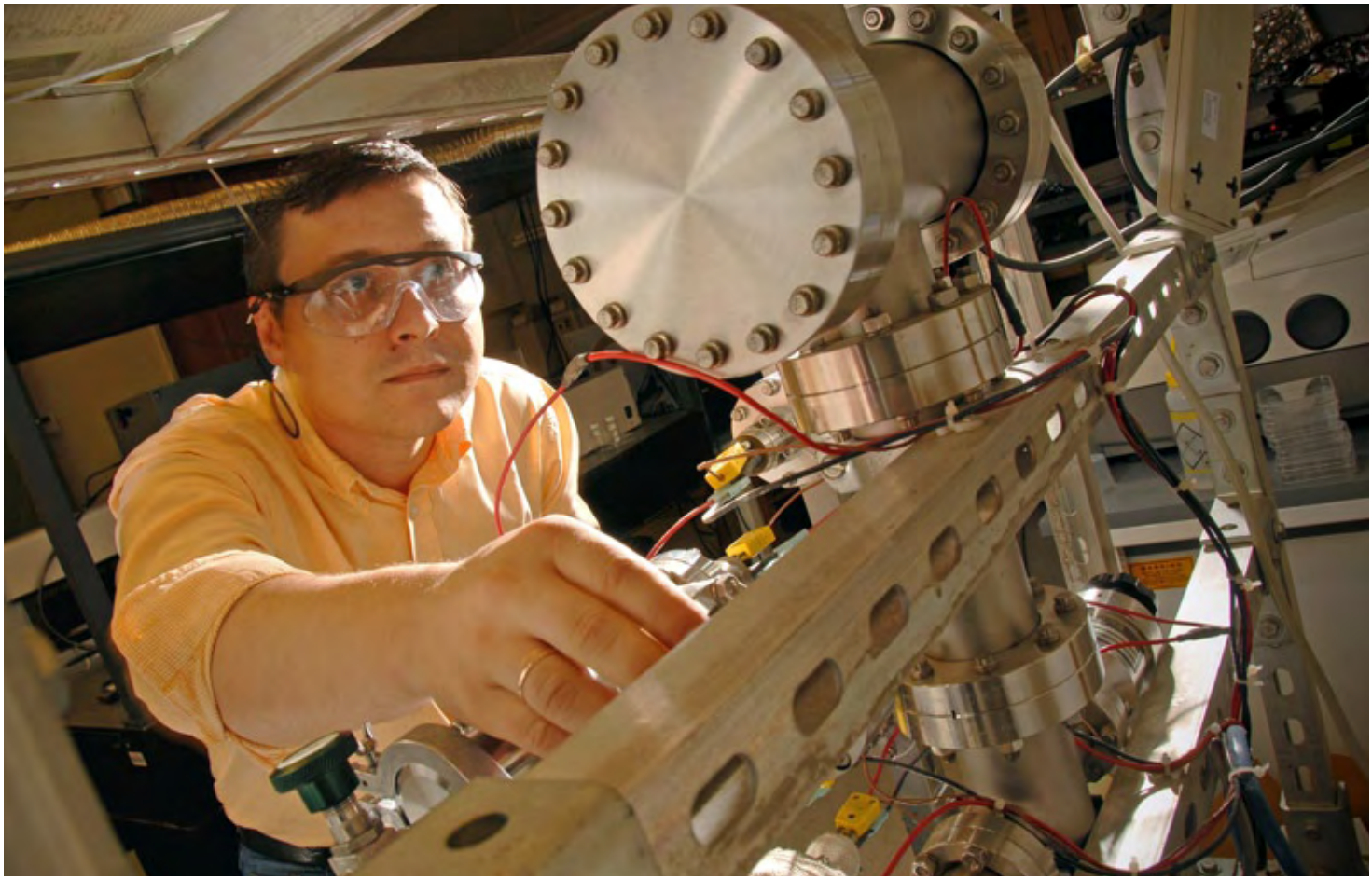
NC State engineers are trying to give them some relief, taking cues from Mother Nature.

When Drs. Jan Genzer and Kirill Efimenko set out to create a coating for ship hulls that resisted pesky barnacles but didn't poison the water, they began with a simple premise.

"You cannot outsmart Mother Nature," Genzer said. "She will find ways to combat you."

Rather than fighting nature, the researchers tried to mimic it. Their creation, which shares characteristics with certain living materials, was a non-toxic "wrinkled" coating that could potentially save boat owners millions of dollars in cleaning and fuel costs. The research, published in the journal *ACS Applied Materials & Interfaces* in May 2009, in collaboration with researchers at the University of Birmingham in the United Kingdom, showed for the first time that surface coatings containing nests of different-sized wrinkles are effective in preventing barnacles from firmly latching on to the coatings. »





» To understand how Genzer, Celanese Professor and Efimenko, research assistant professor, both in the Department of Chemical and Biomolecular Engineering, arrived at their creation, it is helpful to understand the importance of rough and wrinkled surfaces in nature.

In general, rough surfaces tend to stay free of unwanted dirt and other debris, while smooth surfaces tend to accumulate it. This seems counterintuitive, but natural examples abound. Whales, whose massive frames are covered with smooth skin, often carry barnacles as unwanted hitchhikers. But sharks have sandpaper-like skin that remains barnacle-free.

Another example of this phenomenon can be seen in plants. Surfaces of plant leaves are hierarchically-roughened, and this unique surface topography helps channel water across the surface, keeping it free of dirt and other deposits. This helps the plant avoid injury and perform photosynthesis.

These natural phenomena have prompted researchers in many fields to consider roughness and wrinkles as they design surface coatings.

EVEN AFTER 18 MONTHS IN THE WATER, THE WRINKLED MATERIALS REMAINED FREE OF BARNACLES, WHILE FLAT COATINGS WITH THE SAME CHEMICAL COMPOSITION SHOWED PLENTY OF BARNACLE BUILDUP.

Genzer and Efimenko stumbled onto their wrinkled coating almost by accident. In 2005, they were conducting an experiment on a piece of silicon rubber and inadvertently created a hardened wrinkly surface. Upon examination, the researchers saw five distinct generations of wrinkles of various sizes, with each new generation "carrying" the old one.

"Basically, the wrinkles have their 'infant' wrinkles, which have their 'infant' wrinkles, and so on," Genzer said.

The researchers began thinking about how to form their wrinkles consistently and how industry and government could take advantage of their discovery. The U.S. Office of Naval Research sponsored their work.

Barnacles latching onto ships might appear to be just an aesthetic problem, but looks can be deceiving. Barnacles increase the ship's "drag" in water, forcing the engine to burn more fuel to maintain the same speed. After several months, a

ship's fuel consumption increases substantially, costing ship owners—including the military—plenty of extra cash.

"It's like running your air conditioner with the windows open," Genzer said.

Barnacle buildup also forces owners to remove ships from the water and place them on dry docks for cleaning. This procedure is cost prohibitive, and it also costs ships valuable time at sea when they could be making money.

Barnacles are particularly troublesome to the military, which often stations its giant aircraft carriers and battleships in harbors for long periods of time.

"Military ships, in peacetime, spend most of their time in a harbor somewhere. They don't move," Genzer said. "That's going to cost you, because you're going to have tons of marine deposits."

For many years, ship owners fought this problem by coating their hulls with toxic substances that resisted barnacle buildup. But those substances killed fish and other marine life in harbors, causing governments around the world to ban ships from using them. These new regulations created interest in developing ship coatings with wrinkled topographies—essentially transforming the whale-like hulls of today into the shark-like hulls of tomorrow.

To see if their accidental discovery could stand up to barnacles, Genzer and Efimenko needed to test it. They repeated their initial experiment by stretching a piece of rubber mechanically and then exposing it to an ultra-violet ozone (UVO) treatment, which formed a thin skin on the rubber. After the skin formed, they released the tension and allowed the material to readjust, which formed the "wrinkles."

The shapes and sizes of these wrinkles were particularly important. The researchers had learned that the surface roughness has to be comparable to the size of the organism that's trying to catch a ride on the ship. If the roughness is too fine, then the organism might think the surface is flat and attach itself, which means a few hundred extra pounds of costly "cargo" for ship owners. If the wrinkles are too large, barnacles will cluster between them.

But by applying just the right combination of the UVO treatment and the degree of strain on the surface, Genzer and Efimenko created five generations of wrinkles that formed concurrently. These tiny wrinkles ranged in length from a fraction of a millimeter all the way down to tens of nanometers (a nanometer is one-billionth of a meter).

With the coatings created, the researchers applied them to several slabs of hull-like materials and dunked them in the ocean off Wilmington, N.C. Then they waited.

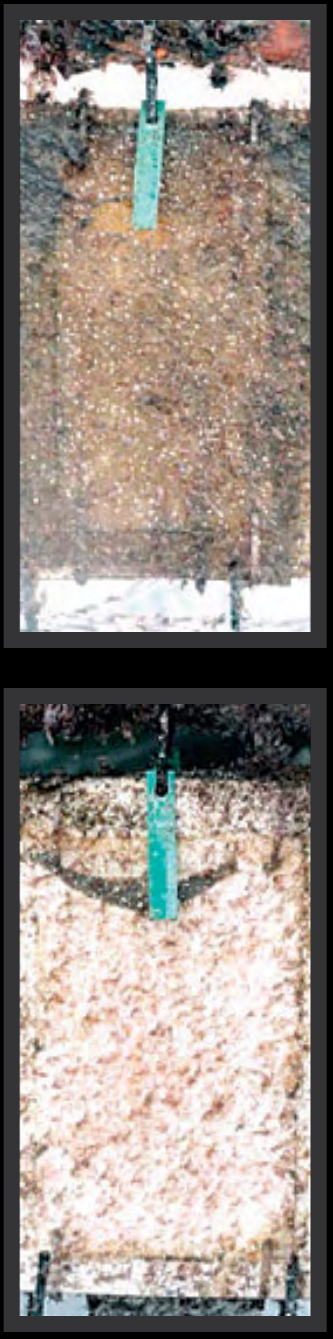
After one month, the flat coatings were covered with barnacles, and just plain "nasty," Genzer said. But the wrinkled materials looked to be barnacle-free. The researchers waited some more, and even after 18 months in the water, the wrinkled materials remained free of barnacles, while flat coatings with the same chemical composition showed plenty of barnacle buildup.

"The results are very promising," Efimenko said. "We are dealing with a very complex phenomenon. Living organisms are very adaptable to the environment, so we need to find their weakness. And this hierarchical wrinkled topography seems to do the trick."

Perfecting the "wrinkling" process will require much more work. For the coatings to be effective, the researchers explained, they'll need to work against the array of ocean organisms that live in harbors around the world, so they're working with marine biologists on multiple testing sites in Hawaii, Florida, the United Kingdom and Singapore.

They'll also continue work on refining the mechanical, physical and chemical properties of the coatings. Some day, researchers hope, their efforts at copying Mother Nature will allow ships everywhere to sail from harbors free of barnacles.

"This is just the beginning of this process," Efimenko said. ▪



Above: The researchers tested the wrinkled coating in seawater in Wilmington, NC. After nine weeks, the flat panel (top) showed much more unwanted material buildup than the bottom panel, which had the wrinkled coating.

Opposite page: Dr. Kirill Efimenko, shown here in his lab on Centennial Campus, and Dr. Jan Genzer are finding ways to keep troublesome barnacles off ship hulls.

CENTEN

NIAL moments

As Centennial Campus turns 25 years old, College leaders look back at engineering's impact on the crown jewel of NC State.

An artist's rendering of the completed Centennial Campus. Construction plans have changed since the rendering was produced, so not all buildings will appear as they do here.

To see the gleaming glass, stately brick and maturing oaks that now occupy NC State's Centennial Campus, it is easy to forget that it wasn't always this way.

But Dr. Tom Dow remembers.

He remembers driving to his campus office on a lonely dirt road through the woods. He remembers the contractors banging away in the floors above his office. He remembers the telephone service going out as crews worked to extend the lines.

Those inconveniences, however, were far outweighed by the next-generation features of Research I, which in 1988 became home to Dow's Precision Engineering Center—the first occupant of Centennial Campus. The air in each laboratory could be exchanged in 40 seconds, and the temperature could be controlled to one-tenth of one degree. Underfoot were thick concrete slabs resting on pads that limited vibrations, necessary features for researchers creating devices that must be of a precise shape and size to operate correctly.

"I was excited about the building then and still am," said Dow, who remains the center's director. "It's a wonderful facility."

Centennial Campus turns 25 years old this year, and it continues to draw attention as a unique combination of education, research, industry, government and community. Located on a 1,334-acre site adjacent to NC State's main campus, Centennial is home to more than 130 companies, government agencies, and NC State research and academic units. More than 2,200 corporate and government employees work at the campus alongside more than 3,400 faculty, staff and students.

The nation is noticing. In 2007, the campus was named the Research Science Park of the Year by the Association of University Research Parks.

Engineering has a large footprint on the campus. When Engineering Building III is completed next year, a majority of the College's academic departments will be located at the campus in facilities comparable to the finest in the country. The campus environment, which puts academic buildings in close proximity to companies like ABB and Red Hat (which has its corporate headquarters on the campus) lets students and faculty collaborate with the brightest minds in industry.

"This campus is a tremendously attractive place for the College of Engineering to be a part of," said Dr. Louis A. Martin-Vega, dean of the College, "and at the same time, we feel that the College of Engineering plays a significant role in attracting other industries and agencies to be a part of it."

Centennial Campus is about much more than just engineering, but engineering played a huge role in its development. NC State engineers brought people together, found common ground and urged those in power to see the common good of Centennial's vision. Engineering alumni have helped build the campus, and some even go to work there.

The campus dates to 1984, when Gov. James Hunt allocated 385 rolling acres in west Raleigh to NC State. More land was allocated later, and the University drew up a master plan to develop the property under the direction of Chancellor Bruce Poulton and Claude McKinney, who was dean of the College of Design at the time and later became the campus' chief planner.

The vision was bold. The campus would have academic and research buildings, but it would also have space for industry and government offices that could provide fruitful partnerships for NC State. Throw in a golf course, a middle school, coffee shops and restaurants, along with apartments for students and faculty, and the new "technopolis" was to set a new standard for university communities across the nation.

"We don't call it a 'research park,'" said Dennis Kekas, associate vice chancellor for Centennial Campus partnerships, "and that's by design."

Helping to spur the campus' development was Dr. Larry Monteith, NC State's dean of engineering from 1978 to 1989. Monteith had been part of a group that helped shaped the concept of Research Triangle Park, and early on in the Centennial planning process he saw the unique opportunity the campus presented. As dean, he envisioned a large engineering graduate research center on the campus, and eventually he began talking to his engineering colleagues about moving the entire College to Centennial.

By the time Monteith took over as chancellor in 1989, NC State had broken ground on its College of Textiles on Centennial, and planning and design of the Engineering Graduate Research Center had been approved. Monteith helped work out a way to bring more third-party tenants to Centennial without the need for state bond referenda, speeding the campus' development.

A big boost came in 1993, when North Carolina voters approved a bond referendum that included funding for the Engineering Graduate Research Center. When completed four years later, the state-of-the-art multidisciplinary research facility included a three-level art galleria fronted by a brick plaza sitting atop a five-and-a-half-level underground parking garage. Adjoining it was the Constructed Facilities Laboratory, which allows full-scale testing of bridge supports and other large structures.

Appropriately enough, the new research building was eventually renamed the Larry K. Monteith Engineering Research Center.

In 1996, Dr. Nino Masnari, a professor of electrical engineering, was named dean of engineering. Masnari had been leading a National Science Foundation Engineering Research Center from his office near Dow's group in Research I, so he was no stranger to Centennial.

Masnari knew what Monteith knew, that the most recent engineering building on main campus had opened in the early 1960s, and he realized that simply renovating those buildings would not bring them to the standards of a top 21st-century engineering school. Like Monteith, he believed the entire College should move to modern buildings on Centennial. As dean, he made that move his top priority.

"I think all of us looked at Centennial Campus as the future for the College of Engineering," Masnari said.

Before Monteith retired as chancellor in 1998, he had worked on a plan to not only move engineering to Centennial but also refurbish the vacated engineering buildings so other academic units, such as the College of Physical and Mathematical Sciences and the College of Humanities and Social Sciences, could move in. Masnari became a strong advocate for the plan, tirelessly promoting it with deans of other colleges. The plan eventually won support, meaning NC State could stand united in its dealings with state government.

"You can't be successful without being persistent," Masnari said.

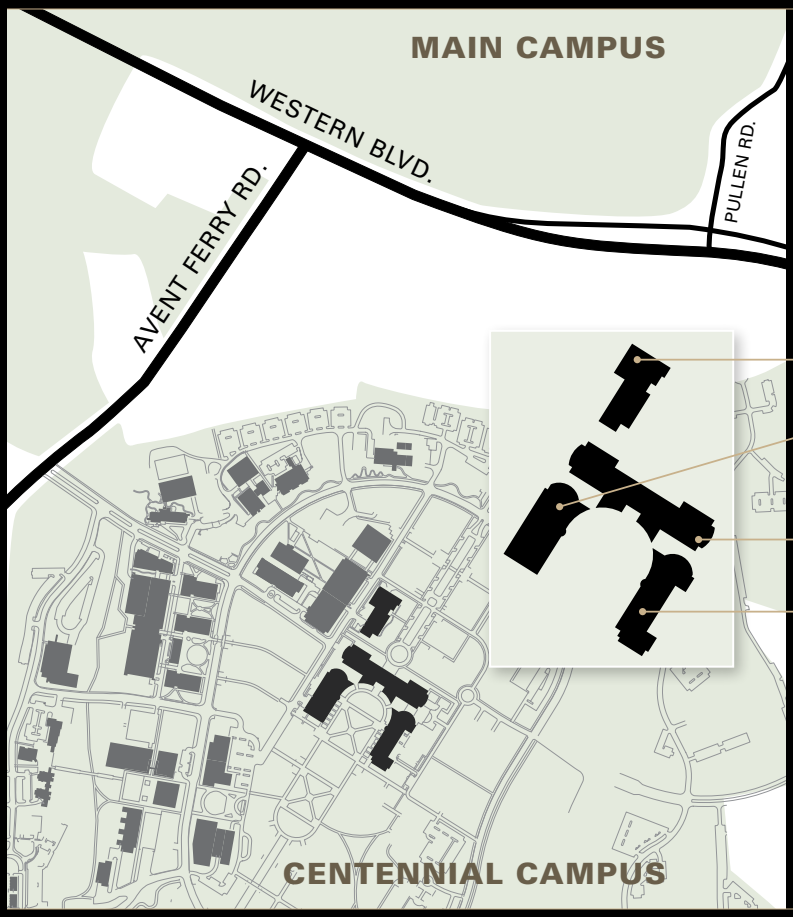
Today, Martin-Vega calls the building of that coalition "remarkable," and a major reason for the growing national ranking and reputation that not only the College, but the entire University, enjoys today.

The next big break came in 2000. Faced with a growing university and community-college system, state leaders put forth a $3.1 billion bond referendum for new higher education facilities. Part of the proposal included funding for two new engineering buildings that would house four departments, as well as renovations to buildings on the main campus.

The measure passed overwhelmingly, and within two years construction was underway on Centennial. By 2005, both buildings had been completed.

The effects were immediate. Students and faculty could now work in cutting-edge laboratories with the latest equipment. Common areas provided space to relax, communicate and collaborate. Modern conference rooms were used by students and nearby companies.

"I don't think you can project yourself as a leader in engineering education, research and technology unless you are leading in terms of the physical capabilities and the infrastructure that you have for your faculty and students," Martin-Vega said.



A NEW HOME

The College of Engineering has research facilities in many parts of Centennial Campus, but the academic departments are concentrated in Engineering Buildings (EBs) near what is known as "the oval."

BTEC Golden LEAF Biomanufacturing Training and Education Center *(opened 2007)*

EB I Chemical and Biomolecular Engineering; Materials Science and Engineering *(opened 2004)*

EB II Computer Science; Electrical and Computer Engineering *(opened 2005)*

EB III Biomedical Engineering; Mechanical and Aerospace Engineering *(to open summer 2010)*

EB IV Engineering Administration; Industrial and Systems Engineering *(planned)*

EB V Civil, Construction, and Environmental Engineering; Nuclear Engineering *(planned)*

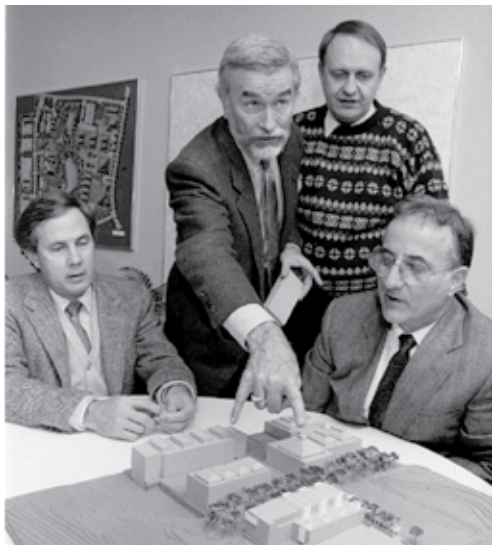
Along the way, College alumni have helped. Kimley-Horn and Associates, Clancy & Theys, Shelco and other engineering and construction firms with College alumni in leadership positions have helped build the campus, and McKim & Creed, co-founded by another alumnus, has its Triangle office there.

In recent years, the good news has continued to roll in. The Golden LEAF Biomanufacturing Training and Education Center (BTEC), the largest center of its kind in the nation, opened on the campus in 2007. In that same year, funding was approved for a third Engineering Building that is slated to open in summer of 2010. It will house the departments of biomedical engineering and mechanical and aerospace engineering and be the home to more than 100 faculty and staff and 2,000 students.

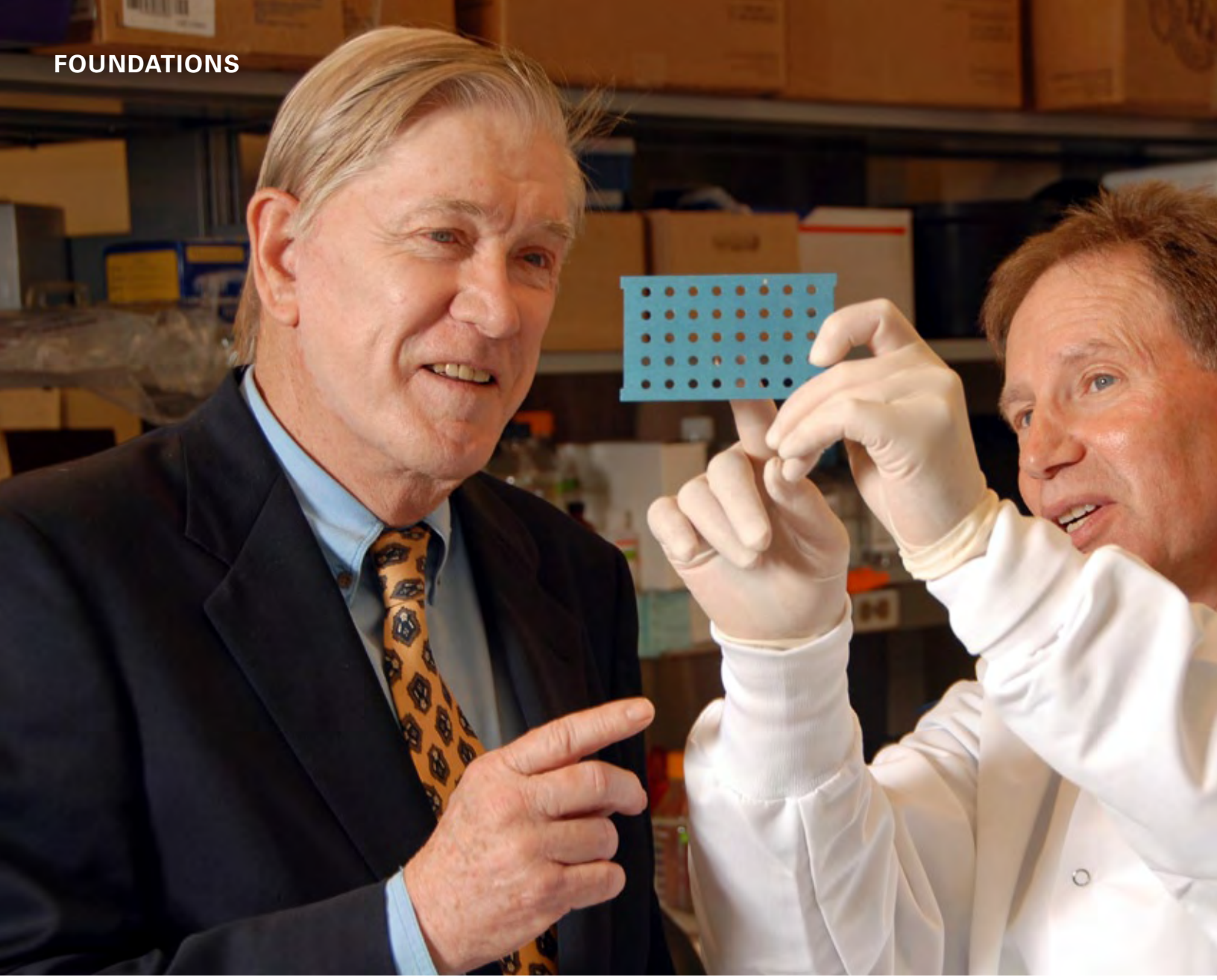
Earlier this year, construction began on a new home for the FREEDM Systems Center, a National Science Foundation Engineering Research Center working on smart-grid technology to transform how the nation uses energy. Also planned is the James B. Hunt Jr. Library, which will stand near the engineering buildings as the intellectual and social heart of the campus.

As construction on Engineering Building III finishes next year, College leaders are already working toward securing construction money for the final two buildings. Then the College's relocation plan—on a campus 25 years in the making—will have come together. College leaders are ready.

"While we appreciate all the support that has brought us to this point, I'm as anxious as anybody, and more, to see this vision come together," Martin-Vega said. ▪



From left, Jerry Whitten, Claude McKinney, Ralph Cavin III and Chancellor Larry Monteith look at a model of Centennial Campus buildings in January 1991. Monteith, who was also dean of engineering for 11 years, helped plan the campus.



FILLING A NEED

Alumnus Fred Gant runs a pharmaceutical startup that could affect **millions** of lives.

The odds are not in Fred Gant's favor.

Here's why. Only one out of every 10,000 new chemical entities synthesized by pharmaceutical companies will survive the rigorous Food and Drug Administration process and become available to patients.

But these long odds have not deterred Gant, an NC State industrial engineering alumnus, or BioMarck Pharmaceuticals, the drug company he started.

BioMarck is looking to develop a first-in-class drug that has the potential to inhibit mucus secretion and inflammation in the lungs of patients suffering from chronic obstructive pulmonary disease (COPD).

The new product is based on scientific concepts developed by Dr. Kenneth Adler, a world-renowned professor of cell biology at NC State. It was his research that discovered that a molecule called the MARCKS protein controls mucus secretion, a first step towards treating COPD. Successful tests on animals gained worldwide attention after the results were published in the journal *Nature Medicine* in 2004.

"Every time we tried this drug in laboratory animal studies, it's been highly successful, to a point you rarely see in science," Adler said.

In the US alone, COPD affects at least 12 million people and causes 120,000 deaths per year, making it the fourth leading cause of death in the country. The disease kills three million people worldwide each year, and it is expected that more than 50 million people will suffer from COPD by 2010.

"If successful, the drug will change their lives and the treatment of the disease forever," said Gant, BioMarck's chief executive officer.

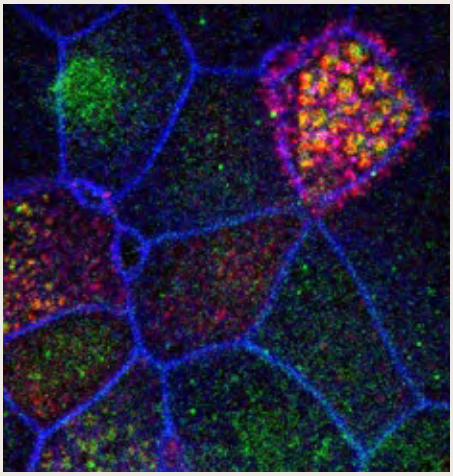
Gant has reason to be optimistic. Preclinical tests in animals have shown that the drug decreases mucus secretion and blocks inflammation. The technology could also address a variety of other pulmonary diseases, including asthma, chronic rhinitis and possibly cystic fibrosis. COPD was targeted because it is the deadliest.

Gant didn't land the job atop BioMarck by accident. Technology transfer officials at NC State recruited him in 2001 because of his long and successful career in the pharmaceutical industry.

After graduating from NC State in 1955, Gant held executive positions with both Merck and the pharmaceutical giant Pfizer. He was then recruited to join Key Pharmaceuticals, a Miami-based startup, where he helped grow the company from $7 million in revenues to $200 million. The company was sold in 1986 for $700 million, leaving Gant financially secure and able to retire.

But after two years, he grew bored and returned to work in the industry. He retired again in 1995 and got involved with NC State, serving on various boards and committees, including the NC State Engineering Foundation Board of Directors. He also established five academic scholarships in industrial engineering that have helped more than 20 engineering students pay for their undergraduate and graduate education.

But the opportunity to help millions of people was something Gant couldn't pass up. So Gant, along with Adler and other founders, started BioMarck. By the end of this year, BioMarck hopes to successfully complete a clinical study on COPD patients. At that point, the company will likely license the drug, named "Bio-11006," to a large pharmaceutical company that would conduct the remaining large clinical studies required to achieve final FDA approval for marketing the drug.



Above: BioMarck's drug in action. In several cells, a green-stained peptide binds to red-stained mucin granules, chief components of mucus, and likely blocks their release. This effectively inhibits mucus secretion in the respiratory airways and lungs, which could provide relief for patients suffering from COPD.

Opposite page: Fred Gant, left, and Dr. Kenneth Adler helped found BioMarck Pharmaceuticals, a company dedicated to developing drugs that treat pulmonary disease.

BioMarck's scientific success has been bolstered by financial success. To date, Gant has raised $17 million from investors and National Institutes of Health grants. But Gant receives no pay for his work, and he prefers to keep BioMarck's operations streamlined. The company owns no buildings and has only a small number of paid employees. Everything else is contracted out.

Sometime soon, Gant will know if the promising drug he's spent so many years developing will have a chance to get to the patients who need it.

"The science leads us to be optimistic that we will be the one in 10,000 that makes it," he said. ▪

Materializing success

The professorship held by NC State's Jay Narayan was created by another legendary materials researcher, John Fan.

John Fan

Jay Narayan

When it comes to electronic materials, Dr. John Fan knows what he's talking about. The world-renowned electrical engineer, now president and CEO of Kopin Corp., is a dynamic leader in the areas of transistor wafers and ultra-small liquid crystal displays.

So it is no surprise that the holder of the John C.C. Fan Family Distinguished Professorship in Materials Science and Engineering at NC State is another standout in the field, Dr. Jagdish "Jay" Narayan. Narayan's research has proven pivotal to the understanding of basic phenomena in metals, ceramics and electronic materials and processing. His work includes seminal contributions in laser processing, semiconductor alloys and many other areas.

"It's easy for me to understand and appreciate who is at the top of this field," Fan said. "Dr. Narayan is extremely gifted."

Fan is not the only one who has recognized Narayan's work; his list of awards is unique among the world's materials scientists and engineers. The Materials Research Society named Narayan as one of its 34 inaugural Fellows for his pioneering research accomplishments, and he is a life member and Fellow of the Minerals, Metals and Materials Society, an honor limited to 100 living members. Narayan is also a life member and Fellow of the National Academy of Sciences in India, an honor limited to 100 foreign members, and has received a Gold Medal from ASM International, the world's largest materials science and engineering society.

Narayan's research is also closely related to the work done at Kopin, perhaps best-known for its CyberDisplay technology found in many digital cameras and camcorders. Narayan holds 10 patents with Kopin that have been important to the success of CyberDisplay and the company's solid state lighting and devices. He also leads the National Science Foundation Center for Advanced Materials and Smart Structures at NC State, which works closely with Kopin.

The close relationship benefits both Fan and Narayan. The professorship funds give Narayan the opportunity to hire students and post-docs to assist his research, which in turn gives students experience working with a world-renowned researcher. The endowment funds are also used for travel to conferences, bringing well-known speakers to NC State and as seed money that can help bring a promising new idea to fruition.

"The endowment helps us build new alliances, generate new ideas and raise our visibility," Narayan said. "Dr. Fan has made a wonderful contribution that will benefit NC State and the nation for years to come."

Fan and Narayan had known each other long before Fan established the professorship in 2002. They had met in the 1970s when Fan was at MIT's Lincoln Laboratory, running the lab's electronic materials group and conducting research on semiconductor materials and devices. Narayan was at Oak Ridge National Laboratory during that time, acting as senior scientist and leader of the lab's thin film microscopy group. They found that they were interested in similar research areas, and their work together included publishing joint papers and co-editing some books.

Narayan joined NC State in 1984, a year before Fan left MIT to start Kopin. In 2002, nanotechnology was still in its infancy, and Fan thought it would benefit his company to fund a researcher in the fast-growing field. He established the professorship, and Narayan has held it ever since.

NC State leaders recognize the endowment's importance. Dr. Larry Monteith, chancellor emeritus and a former dean of engineering at NC State, said the professorship gives NC State and Narayan "an inspiration for achievements that discover and apply properties of complex and rare materials to the urgent needs in our society."

Narayan has continued to be a leader in the field, and his list of published articles has passed 500 with more than 35 patents. Fan has been impressed with Narayan's recent nanoparticle research that could one day improve engine efficiency, work that he feels echoes Kopin's commitment to serving the country through innovation.

"It's a win-win situation for everybody," Fan said. ▪

Generous alumni give more than $270,000 to support scholarship endowments, which have dropped in value during the recession.

Boosting the Bottom Line

When Joseph Colson Jr. established a scholarship endowment at NC State 10 years ago, he did it to honor his father. So when NC State called a few months ago to ask him for some additional support for the endowment, the alumnus asked himself, "what would my father do?"

Sending talented students to college, his father would have said, is worth the price.

"It didn't require a whole lot of soul searching to do it," Colson said. "We just thought it was the right thing to do."

Thanks to the generous support of Colson and other alumni, the College raised $273,630 to support endowments that were "under water," which means the endowments were worth less than their original value with no scholarship funds available for distribution to students. Endowment funds are typically placed in more conservative long term investment instruments, but when the stock market lost more than half its value in late 2008 and 2009, many endowments suffered.

But when NC State development officials asked alumni to help prop up their endowments, they responded in droves. Eighty-one percent of those asked contributed. Combined with additional funds from engineering departments and the Chancellor's office, the College was able to renew scholarships for all eligible students.

"We can't thank our alumni enough for their generous gifts in support of these endowments," said Ben Hughes, executive director of the NC State Engineering Foundation. "This additional support will help ensure that scholarship funds are available for our top engineering students, some of whom might otherwise have to take out additional loans, take on after-school work or, worst of all, possibly have to drop out of college."

Among those students are the beneficiaries of the Dr. Joseph S. Colson Scholarship Endowment, which supports several merit scholarships for engineering students at NC State. The scholarship was the younger Colson's way of helping out, something with which his father, a longtime Granville County physician for whom the scholarship is named, was intimately familiar.

Joseph Colson Jr., who graduated from NC State in 1968 with a B.S. in electrical engineering, parlayed his engineering education into a long and successful career with AT&T and Lucent Technologies. In 1993, he was named one of America's most powerful black executives by *Black Enterprise* magazine. The College named him a Distinguished Engineering Alumnus in 2001 in recognition of his accomplishments.

Colson credits his education at NC State with much of his success, yet another reason why he chose to give back to the College during this difficult economic period.

"These students are our future," Colson said, "and we must invest in their success." ▪

donor stories

WYATTS PLAN DEFERRED SCHOLARSHIP ENDOWMENT

Mark Wyatt

Computer science alumnus Mark Wyatt and his wife, Robin, have formally established plans for a deferred scholarship endowment for incoming freshmen in the College of Engineering. When fully in place, the endowment will have an estimated value of more than $500,000.

At the time the endowment plan was announced, it represented the largest known planned gift ever received from an NC State computer science alumnus. Students from Statesville Senior High School or Mount Pleasant High School, where Mark and Robin attended high school, will be given first preference for the scholarships. The awards will be renewable for up to three additional years.

Mark Wyatt received his B.S. in computer science from NC State in 1980 and has worked with Duke Energy for more than 28 years. He currently serves as vice president of smart energy systems at the company. He has also been a strong supporter of NC State, serving as a member of the Physical and Mathematical Sciences Foundation's Board of Directors, and currently serving as the chair for the Department of Computer Science's Strategic Advisory Board.

Robin Wyatt graduated from Appalachian State University in 1981 with a B.S. in technology and retired from Duke Energy in 2003 after 22 years. The couple lives in Concord, NC. ▪

SHELCO ENDOWMENT BENEFITS STUDENTS

Shelco, Inc., and its employees have made two gifts totaling $47,500 to support the Department of Civil, Construction, and Environmental Engineering.

The Raleigh-based construction company and its employees donated $25,000 to establish the Shelco Student Experience Fund to fund student travel to construction sites and other related student activities. The company also gave $22,500 to renovate the student lounge in Mann Hall, the home of the department.

Shelco has a long relationship with the College. The company's president, D. Edwin Rose, graduated from NC State in 1982 with a B.S. in civil engineering, and the company employs many NC State engineering graduates. Executive Vice President Barry Gardner sits on the CCEE Advisory Board, and Executive Vice President Dan Perry sits on the CCEE Development Committee. Both are CCEE alumni.

The company has also been chosen to build the Centennial Science Center, which will house the FREEDM Systems Center on Centennial Campus. The 72,000-square-foot building should be completed in the summer of 2010. ▪

MCDONALD-YORK EXECUTIVES ESTABLISH CONSTRUCTION ENGINEERING ENDOWMENT

Executives of the Raleigh-based general contractor McDonald-York, Inc., have finished plans to install a $150,000 endowment to aid students in the Department of Civil, Construction, and Environmental Engineering (CCEE).

The McDonald-York Construction Innovation Initiative will fund course lectures, enhance senior capstone projects, bring distinguished speakers to a seminar series and provide additional offsite experiences for students in the Construction Engineering and Management Program.

The fund was established by John M. McDonald, president and CEO of McDonald-York, and G. Smedes York, the company's chairman who earned his B.S. in civil engineering at NC State in 1963. Both executives sit on the CCEE advisory board. ▪

RBC PLEDGES $200,000 TOWARD WATER RESOURCES RESEARCH

RBC is making a $200,000 national leadership grant to the Water Resources Research Institute (WRRI) at NC State.

The grant supports the Initiative for Sustainable Urban Water Use, which seeks to galvanize efforts to educate public officials, water managers, nongovernmental organizations and the public about the sustainable delivery of water throughout the Southeast.

WRRI has partnered with municipal groups and universities in the region to establish a network through which water delivery-related issues and best practices can be discussed.

WRRI was established by the University of North Carolina system in 1964 to meet the state's water research needs. It is headquartered at NC State within the College of Engineering. ▪

FROM THE FOUNDATION BOARD PRESIDENT

Ed White

In my role as president of the NC State Engineering Foundation, I am fortunate enough to come into frequent contact with the bright young engineers and computer scientists our College prepares and the research faculty who develop innovative solutions to many of our world's most pressing challenges. The work that gets done here consistently amazes and inspires me!

Sustaining this high degree of excellence depends on the continuing support of alumni and friends like you and from our close corporate partners. Our Engineering Foundation builds relationships with key constituencies and secures private financial support that will propel the College toward the shared goals we have for it. Today, when all public institutions of higher education face escalating budgetary uncertainty, our support for the College is more vital than ever to its continuing improvement.

Your commitment has a direct impact on the ability of our faculty and students to fulfill their own dreams and to achieve at the highest levels. In the just concluded fiscal year of 2009, for instance, the Foundation worked with alumni, friends, corporations and foundations to provide more than $1.3 million in scholarship support. That represents nearly 700 undergraduate students whose lives have been forever affected for the better.

We are indeed thankful for such a high degree of impact. But when all of us who have such strong affinity for the College consider the support that is extended by some of our peer institutions, schools with whom we compete for the best and brightest, we must commit to do more. Our goal as a Foundation, marching lockstep with a College that continues to grow at a tremendous clip, must always be to build on current levels of support so that we can attract truly exceptional students and faculty to NC State Engineering and reinforce their work.

So, please take a moment to be proud, as I am, that you are a part of one of the nation's premier colleges of engineering, an institution that is well known the world over for doing the important educational, outreach and research work that society demands of engineering. I hope that you will also consider supporting the College and help drive it to fulfill the bold vision that Dean Louis Martin-Vega has set.

Ed White, B.S. EO '78, *is President of the NC State Engineering Foundation Board of Directors*

BY THE NUMBERS

A look at some of the figures that shape the College of Engineering.

$128 million
estimated annual research expenditures.

Among the research areas is the development of digital games, including military, medical and educational applications.

660
Enrolled distance-education students in Fall 2008, the most of any public distance-education engineering graduate program in the nation.

11
Members of the National Academy of Engineering, the nation's most prestigious honor for engineers.

50,550
Total living alumni.

25
World ranking among engineering/technology and computer science colleges in the Academic Ranking of World Universities.

Foundation Year in Review

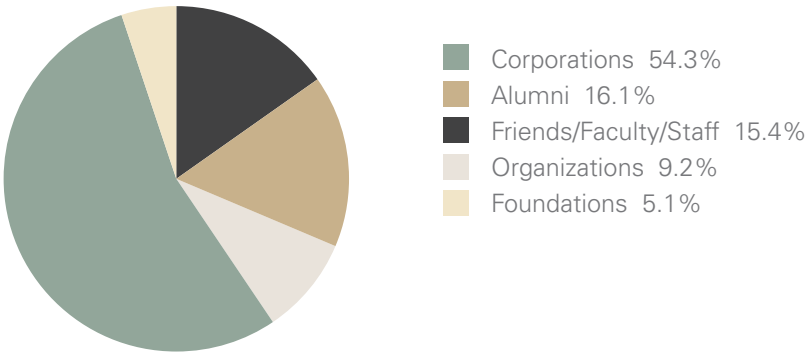
Alumni and friends, corporate partners, continue to invest in the long-term future of the College of Engineering.

The NC State Engineering Foundation enjoyed a productive Fiscal Year 2009, raising nearly $14 million to support the enterprising work being done by students and faculty in the College of Engineering. Despite the recent economic crisis and accompanying uncertainty, alumni and friends and valued corporate partners have continued to make generous investments in the College. The charts below illustrate the sources and uses of private support that came into the College over the past year.

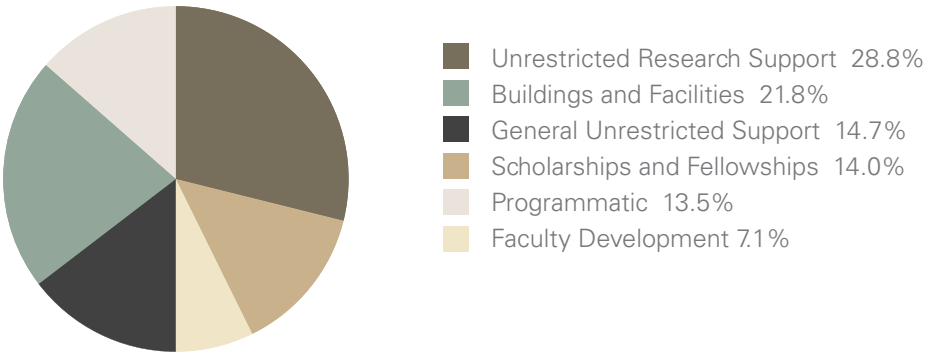
On behalf of the College, the Foundation expresses its sincere thanks for the wonderful commitment shown by our partners. Your support has a tremendous impact on the College and the lives of its students and faculty.

The Foundation looks forward to building on this strong base of support. Our primary objective will continue to be raising gifts to the College's endowment, the most important, dynamic and enduring investment donors can make in the institution. The principal of an endowment gift is invested and always remains so while annual income is used to support the donor's purpose, meaning that the impact of these gifts touches many lives and is permanent. Opportunities are tailored to suit the needs and interests of the donor. ▪

NCSEF Source of Gifts 2008/2009



Private Support to the College of Engineering 2008/2009



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