

**1. Changes in Service Environment**

Like our colleagues across campus, the College of Physical and Mathematical Sciences (PAMS) faced many challenges this year related to the global economic downturn. However, we remain as committed as ever to protecting the student experience and maintaining our momentum in strategically targeted research and public service.

PAMS continues to respond to the growing national challenge to increase the quantity, quality and diversity of students pursuing science, technology, engineering and mathematics (STEM) careers. Meanwhile, we seek to increase our research in the strategic thrust areas of health, energy and environment. Both of these efforts are well aligned with the University's strategic goals and address some of the most important challenges facing North Carolina, the nation and the world.

With this year's opening of SAS Hall as the new home of the mathematical and statistical sciences, along with recent moves into renovated and/or expanded space in Riddick Hall, Jordan Hall, Cox Hall and Bureau of Mines, the overall quality of our teaching and research facilities is quite good. The one notable exception is the continuing need for a safe and modern facility for research and upper-level coursework in the Department of Chemistry (this need is discussed in "11. Recommendations and Concerns for the Future).

**2. Compact Plan**

While the economy has slowed our progress, PAMS has continued to implement, when prudent, the initiatives laid out in our Compact Plan that will allow us to move forward in research and graduate education while continuing to provide access and high quality in our core teaching across the University.

Four new tenure-track faculty members recruited to join us this fall support our compact initiatives in health, energy and environment. The four hires bring new expertise in the specific areas of aerosol-climate interactions, atmospheric predictability, biostatistics and pharmacology. We also established the Cooperative Institute on Climate and Satellites (CICS), which directly supports our compact initiative on environment and is covered under the "16. Driving innovation in energy and the environment" heading.

We also continued to enhance the productivity of our research faculty and limit the potential budgetary impacts to our course offerings by filling a fraction of our faculty vacancies with career-path, special-rank faculty. These Teaching Assistant Professors (TAPs) are expert educators with significantly higher teaching loads than research active faculty. They are expected to keep abreast of innovation in postsecondary teaching and learning and to serve as infective agents for instructional improvement across the departments. We began the Fall 2008 semester with two new TAPs in mathematics and one in physics, giving us 13 across the College.

PAMS continued its commitment to fostering a scientifically competent society through a variety of means, most notably our annual Scope Academy celebration. One of the University's premier public education outreach programs, Scope Academy this year featured classroom seminars by some of the College's best professors and a lecture on "The Mathematics of Voting" by noted economist and mathematician, Donald Saari.

### **3. Diversity**

According to *Diverse: Issues in Higher Education*, NC State ranks 1<sup>st</sup> among U.S. predominantly white institutions (7<sup>th</sup> overall) in the number of African Americans receiving a bachelor's in the physical sciences, 2<sup>nd</sup> among predominantly white institutions (6<sup>th</sup> overall) in the number of African Americans receiving a bachelor's in mathematics/statistics, and 1<sup>st</sup> among all institutions in the number of African Americans receiving a masters in mathematics/statistics. We continue to enhance our support of minority students through peer mentor programs and other services provided through the Office of Multicultural Affairs and Student Services and programs across the College. We also play a leadership role in the Women in Science and Engineering (WISE) Village, a living and learning community of female students in STEM disciplines.

Two PAMS departments received national recognition for their work to diversify the STEM pipeline. The Department of Statistics was honored by the American Mathematical Society as one of its 2009 Programs that Make a Difference. The department was recognized for outstanding work "in recruiting members of underrepresented groups and mentoring them to successfully complete their graduate degrees." Also this year, the Department of Physics was one of only seven at predominantly white, research-extensive institutions included in a listing of American universities that have awarded the most PhDs to African Americans in the last decade.

The College also continues to promote STEM educational opportunities to pre-college students from underrepresented groups through the various programs of The Science House and our leadership role in the recently established WISE chapter at the North Carolina School of Science and Mathematics (NCSSM). Our efforts to recruit a diverse student population will be enhanced by a new articulation agreement with NCSSM.

#### **4. Instructional Program Advances**

The College once again sponsored a new faculty workshop, led by Richard Felder, Rebecca Brent and some of our most successful teachers, on effective teaching strategies. We are moving forward with the development of a new interdisciplinary freshman course and a new interdisciplinary capstone course to pilot during the 2010-2011 academic year. All PAMS departments continue to evaluate, implement and—in many cases—develop the latest in high-quality instructional methods and technologies.

#### **5. Research**

Funded research activity continues to be impressive, with nearly 80 percent of faculty participating in externally funded programs. Nearly 90 percent of competitive grants were from federal sources, a key indicator of the quality of our faculty and programs. The total research expenditures for programs in the college exceeded \$38 million for FY2008.

*Research highlights include:*

Chemistry: Stefan Franzen and a colleague in CALS have successfully modified a common plant virus to deliver drugs only to specific cells inside the human body, without affecting surrounding tissue. These tiny “smart bombs” could lead to more effective chemotherapy treatments with greatly reduced, or even eliminated, side effects.

Mathematics: Tom Banks and his colleagues in the Center for Research in Scientific Computation (CRSC) are working with the Air Force Research Laboratory to develop new technologies for the detection of buried improvised explosive devices (IEDs) in geographic regions of both active and former military conflicts.

MEAS: Matthew Parker and a team of NC State graduate students spent their summer in Tornado Alley as part of the VORTEX2 project, the largest and most ambitious effort ever made to understand tornadoes.

More than 100 scientists and crews from several U.S. universities and weather research programs participated in this unique, mobile, field program.

Physics: How small is too small? Marco Buongiorno-Nardelli has done nanoscale analysis on ferroelectric thin films—materials that are used in electronic devices from computer memories to iPhones and polarize when exposed to an electric charge—and found that when it comes to polarization, both size and location matter. His finding suggests that, in creating tiny electrical devices, the use of extremely small components comes with the possibility of decreased effectiveness.

Statistics: Faculty and students in the Department of Statistics have made significant contributions in the areas of biomedical statistics, environmental statistics, statistical ecology, statistical genetics, Bayesian inference, variable selection, statistics education and time series analysis.

## **6. Extension**

Through its six North Carolina offices and partnerships in several other states, The Science House (TSH) last year served more than 5,000 teachers and 35,000 students. TSH uses teacher training programs, science demonstrations, student camps and various Web and other electronic resources to increase quality of, access to and interest in STEM educational opportunities across the state and around the world.

The State Climate Office (SCO) offers an important resource on climate-related issues for public and private agencies, as well as individual citizens. SCO conducted more than 240 hours of direct educational and outreach programming and responded to more than 600 formal requests for information from industrial, governmental and educational clients.

Faculty and staff across the College provide outreach and extension service through classroom, club meetings and public agency presentations, demonstrations, field visits and consultations. David B. Eggleston of MEAS and Wandra P. Hill, recently retired assistant dean of multicultural affairs and student services, were among the recipients of NC State's 2009 Outstanding Extension Service Awards.

## **7. Faculty: Selected honors, awards and recognition**

Chemistry: *Alexander Deiters*: National Science Foundation CAREER Award; *David C. Muddiman*: NC State Alumni Outstanding Research Award; *Maria T. Oliver-Hoyo*: NC State Academy of Outstanding Teachers

Mathematics: *Professor Emeritus LeRoy B. Martin Jr.*: PAMS Distinguished Alumni Award

MEAS: *Ryan P. Boyles*: “Tar Heel of the Week,” Raleigh News & Observer; *Matthew D. Parker*: LeRoy and Elva Martin Teaching Effectiveness Award; *Lian Xie*: Certificate of Appreciation, 2008 Summer Olympics

Physics: *Robert J. Beichner*: Distinguished Alumnus, SUNY-Buffalo; *Christopher R. Gould*: President’s Award, Research Triangle Institute International; *David G. Haase*: Chair, Southeast Section, American Physical Society; *Chueng Ji*: President-Elect, Korean-American Scientists and Engineers Association

Statistics: *Pamela Arroway*: NC State Academy of Outstanding Teachers; *Montserrat Fuentes* and *Zhao-Bang Zeng*: Fellows, American Statistical Association

## **8. Students**

Overall, our Fall 2008 undergraduate population was 41 percent female and 9 percent African American, while the graduate population was 39 percent female and 4.5 percent African American.

PAMS undergraduates continue to score among the University’s highest in high school GPA and SAT scores. PAMS ranked first on campus in the percentage its Fall 2008 incoming freshmen who are in the top 10 percent of their high school class.

The College’s continuing and graduating students were also impressive once again this year, earning an array of scholarships, nationally competitive graduate fellowships and awards from professional societies. Seven PAMS students were honored at the May 2009 Honors Baccalaureate ceremony. In addition, Jeff Olander, a May 2009 graduate double majoring in physics and mathematics, was selected in a university-wide contest as NC State’s best example of its “Red Means Go” spirit.

## **9. Fund Raising**

The global economic crisis and significant changes in gift accounting within the university created some challenges this year for the PAMS Office of College Advancement. Despite these issues, the College continued

to build on its successes of the *Achieve! Campaign for NC State*. Total commitments for FY2009 through May 31 are \$5.1 million. Significant achievements this year include establishment of the \$1 million LeRoy B. Martin Jr. Distinguished Professorship in Mathematics and the receipt of \$300,000 in teaching technology equipment and infrastructure for the newly dedicated SAS Hall. In addition, The Science House received a \$200,000 grant from the GoldenLEAF Foundation to provide continuing support of its six regional offices.

## **10. Administration**

Jacqueline Hawkins-Morton was appointed director of advising and coordinator of summer school and Jamila Simpson was appointed director of multicultural affairs and student services. The associate dean for external affairs position and the staff position that supported it were eliminated.

## **11. Recommendations and Concerns for the Future**

The College's share of this year's budget reductions was roughly \$1 million, or 3 percent of our state funding. We were able to limit the impact of these reductions on mission-critical activities by accommodating them primarily through a combination of lapsed salary from vacant faculty positions, including new compact plan positions, and from delaying full funding of start-up packages. Additional accommodations were made by not completing the furnishing of SAS Hall to original specifications.

A central part of PAMS' mission is to serve the University by providing core science and mathematics instruction to students campus wide. While we would put our highest priority on providing these "gateway courses" under any budget scenario, continued significant reductions are bound to impact access and even quality in some of these courses. If PAMS' cut is fully implemented at its current suggested level of \$3.67 million for the next biennium, we estimate an annual reduction of over 2,000 seats. This will negatively impact retention and graduation rates, with consequent increase in the cost of education for NC families. Higher student/faculty ratios, fewer teaching assistants and reduced investment in instructional laboratories and field experiences will have an impact on the quality of learning afforded to many students.

A loss of tenure-track faculty lines leaves fewer personnel to mentor graduate students; reduces the range and frequency of distinctive specialty courses; impedes progress in our critical research areas; and reduces external funding, including support for graduate students. Consequent reduction in graduate student

enrollment has a negative impact on formula funding, loss of productivity for faculty and puts further pressure on the quality and availability of laboratory-intensive courses.

To the extent that we will be able to recruit for new and replacement tenure-track faculty, our competitiveness will be decreased by our reduced ability to meet startup needs, especially in experimental areas. Budget reductions to research and outreach centers will, inter alia, slow the pace of contributions to the biotechnology industry, to coastal economic development, to the development and retention of science and mathematics teachers, and to climate-related public safety across the state of North Carolina.

The College also continues to face a critical need for a safe and modern facility for research and upper-level coursework in the Department of Chemistry. Such a facility is vital, not only to the long-term success of PAMS faculty and students, but to every research program across campus that requires our substantial contributions in the physical and mathematical sciences. Moving forward as much as possible now for a new facility should be a top priority of the university. Doing so will allow us to have a comprehensive proposal ready for the state legislature to consider once construction funds again become available.

## **12. Producing leaders for the state, nation and world**

PAMS consistently produces graduates with the tools to become leaders in academics, industry and government. This year is no exception, as evidenced by May 2009 graduates Kristen Gore and Ryan Going. Gore, a double major in statistics and meteorology, is a 2009 recipient of the Ford Foundation Diversity Pre-doctoral Fellowship and will begin graduate school this fall at Columbia University. Going, a double major in applied mathematics and electrical engineering, is one of only 37 U.S. recipients of the 2008 Gates Cambridge Scholarship.

## **13. Creating educational innovation**

The College has hired two new tenure-track faculty who specialize in disciplinary based educational research. One of these hires is in geosciences education research and the other is in statistics education research. Our eventual goal is to have one or more such faculty in each of our five departments and to provide opportunities for collaboration among themselves and across campus. We also see opportunities for

collaboration with our non-tenure track Teaching Assistant Professors (mentioned under the “2. Compact Plan” heading), whose introductory courses could serve as laboratories for their educational research.

#### **14. Improving health and well being**

The Center for Quantitative Sciences in Biomedicine (CQSB) continued its progress in establishing a presence as a focal point for activities related to the role of the mathematical sciences in human health and in facilitating several specific research projects and partnerships. In addition to their robust portfolio of existing research, CQSB leadership this year were involved in six new applications for health-related research projects, potentially worth more than \$8.4 million in federal funding.

#### **15. Fueling economic development**

PAMS continues to be a University leader in the transfer of academic discovery to commercial application. Our faculty were involved in 12 of NC State’s 35 total patents (34 percent) for calendar year 2008.

We are also fueling economic development through unique research and outreach partnerships, such as the work of PAMS marine ecologist David Eggleston with farmers in eastern North Carolina to raise blue crab in freshwater farm ponds. This effort could simultaneously help local farmers develop new revenue streams and lessen the strain on wild crab populations in the state’s coastal waters. Another new partnership, the new Cooperative Institute Program on Climate and Satellites (discussed more fully in the next section), will bring up to 20 high-paying jobs to the Asheville area over the next five years.

#### **16. Driving innovation in energy and the environment**

Perhaps the most noteworthy, single development of the past year in support of any of our compact research initiatives is the establishment of the Cooperative Institute Program on Climate and Satellites (CICS), which will focus primarily on collaborative research into the use of satellite observations in climate research and applications. This NOAA-sponsored institute is a joint effort between the University of Maryland and NC State, with separate operations at College Park, Md., and Asheville, NC. The new program could generate up to \$32 million in new funding over the next five years.