

## **Request to Establish NCA&T/UNCG Joint School of Nanoscience and Nanoengineering March 5, 2007**

In order to meet the state's increasing need for a well-educated, prepared workforce in nanoscience and nanoengineering, North Carolina Agricultural and Technical State University (NCA&TSU) and The University of North Carolina at Greensboro (UNCG) request permission from the UNC Board of Governors to establish a Joint School of Nanoscience and Nanoengineering (JSNN) pending funding from the North Carolina General Assembly. The Boards of Trustees at both NCA&TSU and UNCG have approved this request.

### **OVERVIEW/BACKGROUND**

Explosive growth in fundamental research, development and commercialization of nanoscience and nanoengineering is affecting almost every existing industrial sector worldwide. These evolving fields are seen as providing stepping-stones to technical advancements that will positively impact the economy, workforce, existing industries and society. Although these nascent nanoscale technologies are still largely experimental, their growth is similar to that of the now maturing biotech industry, which has established a significant record of accomplishment for product approval and manufacturing.

North Carolina is among the leading states in the quality of its research base in nanotechnology. Companies in the areas of the life sciences, energy, automotive and agriculture are integrating nanotechnology and nanoscience into their existing products as well developing new ones. Nanoscale technology is an enabling technology, useful when it is adapted to enhance existing products or processes, thus creating a nucleus for maintaining an environment in which cutting-edge research is translated into new technology (A Roadmap for Nanotechnology in North Carolina's 21<sup>st</sup> Century Economy, 2006).

Since the overall body of knowledge in nanoscience and nanoengineering is critical to future scientific innovations, it is necessary for industry and academia to work in concert to steer the direction of research to enable faster returns on innovations. This necessitates a two-way exchange of knowledge: high tech companies educate academic researchers about entrepreneurship and academic researchers share their fundamental research knowledge and accomplishments with industry. This exchange will generate a new breed of undergraduate and graduate students for the millennium workforce.

NCA&T State University has been funded at an average rate of \$3-5 million per year in the area of nanoscience and nanotechnology. Most of the research in nanoengineering is done in the Center for Advanced Materials and Smart Structures (CAMSS). Several Centers and projects are under CAMSS, including the NSF Center for Research Excellence in Science and Technology (CREST), the DoD Center for Nanoscience, Nanomaterials and Multifunctional Materials (CNN) for Homeland Security, the NSF Nanoscale Science and Engineering Center (NSEC), the NSF project on US/Europe Materials Collaboration: Self-Organized Nanostructured Thin Films for Catalysis, the NSF project on Nanoscale Interdisciplinary Research Teams (NIRT), the NSF Major Research

Instrumentation for Nanoengineering Research, and the NSF Nanotechnology Undergraduate Education (NUE) program. CAMSS also facilitates many of the materials research activities of the NASA-National Institute for Aerospace (NIA). In addition, the Center for Composite Materials Research (CCMR) does research in nano-enhanced composite materials and the Army Center of Excellence for Battlefield Capability Enhancements (Flexible Displays) does research in material characterization and development of novel displays.

At UNCG, the research in nanosciences is concentrated in the Departments of Chemistry and Biochemistry; Physics and Astronomy; Biology; and Nutrition as well as the Center for Biotechnology, Genomics, and Health Research; the Center for Drug Design; and the Laboratory for Molecular Medicine. Overall, the emphasis of the research is in the biosciences. Typical of the type of work addressed in these programs is the identification of viral selenoprotein genes in HIV-1 and hepatitis C virus and other novel viral proteins expressed by ribosomal frame shifting, elucidating the molecular basis for the action of cannabinoids *in silico*, designing novel stationary phases for high performance liquid chromatography for the resolution of complex sample mixtures, and regulation of fat cell differentiation and metabolism. Dr. Albert Link, Professor of Economics and editor of the *Journal of Technology Transfer*, contributes to the development of national policies related to nanotechnology and assisted in the preparation of *A Roadmap for Nanotechnology in North Carolina's 21<sup>st</sup> Century Economy*. Bioethics of biotechnology / nanotechnology is a focus of scholars in the Department of Philosophy. A Center of Research Excellence in Nanobiosciences is in the process of being established. Two faculty are being recruited in the Department of Physics and Astronomy in the area of single molecule reactions.

## **DESCRIPTION OF THE JOINT SCHOOL OF NANOSCIENCE AND NANOENGINEERING**

The Joint School of Nanoscience and Nanoengineering will be a unique, interdisciplinary school, located at the South Campus of the Gateway University Research Park, the joint millennial campus of NCA&T and UNCG (Appendix A). It will have the same status as other colleges/schools at the respective partner universities. To develop this shared academic unit NCA&T and UNCG will recruit premier, highly accomplished scholars in nanoscience and nanoengineering who complement existing strengths on both campuses in the sciences and engineering.

The JSNN will train students to conduct basic and applied research in nanoscience and nanoengineering. It will offer a joint interdisciplinary Ph.D. degree and a joint professional science master's degree (M.S.), strengthen the representation of nanoscience and nanoengineering in undergraduate and K-12 education, provide training for scientists and engineers already in the work force, and engage in activities that influence economic development globally. These programs will link to the entrepreneurial activities at both campuses to better transfer innovations to practice.

### **Academic Programs**

The interdisciplinary Ph.D. program in Nanoscience will have tracks or concentrations to allow for areas of research specialization. The Professional Science Master's program will target students with strong backgrounds in science or engineering to prepare them for positions in nanoscience or nanoengineering research, development, or manufacturing companies. It will be a Master of

Science degree. Since the JSNN is a shared academic unit of the two universities and is unique nationally, graduate degrees will be awarded jointly by both universities. Also, each of the universities will be given credit for the number of graduate degrees awarded.

The doctoral and professional master's programs offered at the JSNN will complement but not duplicate academic programs offered at the partner universities. The program approval processes will assure that this occurs. Students recruited to the JSNN degree programs will be new to the universities and would not normally attend either of the universities.

The joint Ph.D. program in Nanoscience will be submitted for approval following UNC System established procedures. The program will include a core interdisciplinary curriculum that provides a thorough background in the principles and tools required for a research career in nanoscience. Students will take additional elective courses related to their research and professional interests. Admission to the program will require an undergraduate or master's degree in an appropriate science or engineering discipline as well as acceptable test scores.

The professional science master's program will have a biological or chemical emphasis making it unique in the nation. (The only other two professional science master's programs in nanoscience and nanoengineering are at Rice University and University of Albany at SUNY, neither of which offers a biological or chemical emphasis.) The program will consist of 33 credit hours arrayed across the general areas of nanoscience and nanoengineering, nanomanufacturing, business and management, and an internship in a private enterprise. It will be designed so that students can complete the degree in 18 months.

The planning timetable for each program is given below.

### ***Ph.D. Program***

|                |   |
|----------------|---|
| October 2006:  | Planning group begins work to develop doctoral program          |
| May 1, 2007:   | Request to Plan document submitted to GA                        |
| October 2007:  | Planning document presented to UNC Graduate Council             |
| May 1, 2008:   | Request for Authorization to Establish document submitted to GA |
| October 2008:  | Establishment document presented to UNC Graduate Council        |
| December 2008: | Advertisement of program and recruitment of applicants begins   |
| August 2009:   | First doctoral students admitted into program                   |

### ***Professional Science Master's Program***

|                            |   |
|----------------------------|---|
| October 2006:              | Planning group begins work on developing PSM program              |
| April or May 2007:         | Notification of Intent to Plan document submitted to GA           |
| August or September 2007:  | Request for Authorization to Establish document submitted to GA   |
| November or December 2007: | Advertisement of program and recruitment of applicants begins     |
| August 2008:               | First professional master's degree students admitted into program |

## **ADMINISTRATIVE STRUCTURE**

Faculty teaching in programs offered by the JSNN will be drawn from academic departments in the JSNN and academic departments at the partner universities. The JSNN faculty, as well as faculty at both partner universities, will have a variety of options for joint appointments between/among the JSNN and departments at the partner universities. The JSNN faculty will earn tenure and/or promotion in one of JSNN's academic departments and thus, will hold tenure and rank at one of the partner universities.

A Dean will provide academic and administrative leadership for the JSNN. Like other academic units of the two institutions, the School's Dean and the faculty will be responsible for developing and offering academic programs, conducting research, and engaging in educational and economic development activities.

An Inter-University Coordinating Council comprised of the Chief Academic Officers, the Chief Research Officers, the Graduate School Deans, the Deans of Arts and Sciences and the Dean of Engineering at the partner Universities will have responsibility for the overall coordination of the JSNN. The co-chairpersons of the Inter-University Coordinating Council are the Deans of the College of Arts and Sciences at the each of the partner Universities. The Dean of the JSNN will report to the co-chairpersons of the Council. The Council will meet at least twice per academic year; agendas for the meetings will be prepared by the Dean of the JSNN in collaboration with the co-chairpersons.

In the initial years, the Inter-University Coordinating Council will meet more frequently to address issues related to hiring a Dean and faculty, promotion and tenure policies, joint faculty appointments, grants and contracts, including the distribution of Facilities and Administrative budgets, and intellectual property. The decisions made by the Council must not negatively affect the academic units at the partner universities. This joint initiative is designed to be a win-win situation for all participants/academic units.

## **ACADEMIC DEPARTMENTS**

The JSNN will have three departments, the Department of Nanobioscience, the Department of Nanobiotechnology and the Department of Environmental Nanoscience. Each department will have its own areas of specialization. A brief description of each department is given below.

### **DEPARTMENT OF NANOBIOSCIENCE**

The Department in Nanobioscience will focus on the study of biological nanostructures – complex, highly structured devices at the nanometer scale such as molecular matrices, biofilms, and energy capture nanotubules, and light- and chemical-sensing structures. Such studies explore the ways nature has solved various problems in structural design,

energy flow, and molecular recognition. By mimicking nature's creative and often self-repairing solutions, this research helps to develop the knowledge needed to develop and maintain new nanoscale structures. For example, the proteins responsible for intracellular movement may become key components in the synthesis of products with new sensing and energy-transfer capacities. Furthermore, nanoscale transport of single molecules holds the promise of highly improved techniques for drug delivery to specific sites in the body. Research techniques in this specialization are expected to include fluorescence correlation spectroscopy, single-molecule fluorescence resonance energy transfer, two-photon excitation techniques, atomic force microscopy, optical tweezers, nanoscale modeling, bioinformatics, computational biology, and the theoretical study of quantum processes and electrodynamics.

### **DEPARTMENT OF NANOBIOTECHNOLOGY**

In the Department of Nanobiotechnology, where nanobiotechnology is defined as the creation of materials, devices, and systems via control of matter at the scale of 1 to 100 nanometers and the exploitation of novel properties of matter and phenomena at this same scale, potential areas of research will include biosensors, nanoprobess, and bionanocatalysis. A biosensor converts a biological response into an electrical signal, allowing selective identification of toxic chemical compounds at ultratrace levels in industrial products, chemical substances, environmental samples, or biological systems for biomedical diagnosis. Nanoprobess can be used to capture information about cellular interactions at the most fundamental level, as well as identifying protein expression and cellular responses to external stimuli. Such studies reveal how cells communicate with one another and react to the complex biomolecules surrounding them. In turn, this information can be used to create drugs capable of targeting some of the most devastating diseases. Bionanocatalysis uses nanostructures and larger, microscale mechanisms to harness the highly efficient and selective activities of enzymes for applications in industrial biotechnology. For example, enzyme-based biofuel cells show great promise as portable power generation devices for special applications such as implantable devices, sensors, drug delivery, micro-chips, and portable computers.

### **DEPARTMENT OF ENVIRONMENTAL NANOSCIENCE**

The Department of Environmental Nanoscience will focus on the impact of nanotechnology on the environment, the use of nanomaterials to address pollution, and ethical and social considerations arising from the applications of nanoscience. Nanotoxicologists study the biomedical consequences of human, animal and plant exposures to nanoparticles, including problems in skin penetration, lung deposition via inhalation, access via the gastro-intestinal route, allergy, and cellular and systemic toxicology. Nanomaterials provide greatly increased surface area for exposure of contaminated water and environmental materials to catalysts that break down highly toxic organic contaminants into smaller and more easily removable compounds. Nanoassembly of immobilized enzymes can also be used for biocatalysis and degradation of pollutants. Nanobiosensors are critical to monitoring the presence and impact of environmental toxins. Ethical and safety considerations are necessary for the proper use of nanotechnology and to gain public acceptance. Scientists and engineers working with social scientists and

philosophers will collaboratively conduct research in ethical and safety concerns. The potential for nanotechnology to create entirely new industries as well as greatly affect the operation of existing ones creates an important need for research on the consequences for the social and economic environment. The JSNN students will be educated to understand these concepts.

## **RELATIONSHIP OF JSNN TO UNDERGRADUATE PROGRAMS**

Undergraduate courses relevant to the research foci of JSNN will be developed by faculty at the JSNN and departments at the partner universities. Faculty at the JSNN and departments at NCA&T and UNCG will participate in teaching these courses and supervising undergraduate research/senior projects. Successful graduate programs at NCA&T and UNCG who have taken these courses will be accepted into a graduate program at JSNN.

## **RELATIONSHIP OF JSNN TO COMMUNITY COLLEGES**

The joint Ph.D. and professional master's program faculty will collaborate with community colleges to develop short-term worker retraining programs in the subject areas of relevance to the JSNN. Creative curricular arrangements such as 3+2 programs will also be available.

## **RELATIONSHIP TO JSNN TO NANOSCIENCE EDUCATION FOR K-12**

In response to the report "Rising above the Gathering Storm" issued by the National Academy of Sciences, the National Academy of Engineering, and the Institute of Medicine (2006), the JNSS will develop nanoscience programs for K-12. Dedicated outreach personnel will be hired to work closely with elementary, middle and high school educators to bridge gaps and create opportunities for students and teachers. These will include tours, class visits, electronic mentoring, internships, and teacher workshops. Opportunities to conduct summer courses for K-12 teachers and to help them integrate nanobioscience into the K-12 curriculum will also be explored.

## **PHYSICAL FACILITIES FOR JSNN**

The JSNN will be housed at a newly constructed building at the South Campus of the Gateway University Research Park. It is anticipated that the Universities will receive from the North Carolina General Assembly approximately \$50 million in capital funding to plan and construct a building for the JSNN and an additional \$8 million in one-time funding to equip the building. Funding for the project will be spread across two consecutive biennium, 2007-09 and 2009-10. The building will be constructed by fall 2011. Since new faculty hires for the JSNN will occur in 2007-08, students will be admitted into the professional master's degree program in August 2008 and into the doctoral program in August 2009. The JSNN equipment purchases will initially be housed in another soon-to-be-built building at South Campus of the Gateway University Research Park. New and existing nanotechnology centers developed by faculty at the JSNN, NCA&T, and UNCG will also be housed in the new JSNN building. The synergy created by housing faculty

and students affiliated with the JSNN and nanotechnology centers in one place will build on the strengths of the partner universities and will produce an engine for educational and economic development in the Piedmont Triad and beyond.

## **CLOSING REMARKS**

The Joint School of Nanoscience and Nanoengineering will shape the future of Greensboro and the Piedmont Triad by positioning these areas at the cutting-edge of some of the most exciting developments in the sciences and engineering in the 21<sup>st</sup> century. It will be one of the most stimulating opportunities in the history of the area and will serve as a national model for collaboration between two institutions, one an historical black institution and the other an historical white female institution. It represents the type of innovative, collaborative thinking necessary to move the Piedmont Triad from a manufacturing-based to a knowledge-based economy. This joint venture has the potential to unify the community around an economic development initiative as never before.

**PLANNING COMMITTEE  
FOR THE JOINT SCHOOL OF  
NANOSCIENCE AND NANOENGINEERING**

- \*A. Edward Uprichard, Provost and Vice Chancellor for Academic Affairs, UNCG
- \*Janice G. Brewington, Interim Provost and Vice Chancellor for Academic Affairs, NCA&T
- \*N. Radhakrishnan, Vice Chancellor for Research and Economic Development, NCA&T
- \*Rosemary C. Wander, Associate Provost for Research & Public/Private Sector Partnerships, UNCG
- \*James Petersen, Dean, Graduate School, UNCG
- \*William Craft, Interim Associate Vice Chancellor for Research/Dean for the School of Graduate Studies, NCA&T
- \*Michael Plater, Dean, College of Arts and Sciences, NCA&T
- \*Timothy D. Johnston, Dean, College of Arts and Sciences, UNCG
- \*Joseph Monroe, Dean, College of Engineering
- John Merrill, Executive Director, Gateway University Research Park

Faculty

|                    |       |
|--------------------|-------|
| Solomon Bililign   | NCA&T |
| Goldie Byrd        | NCA&T |
| Steve Danford      | UNCG  |
| Margaret Kanipes   | NCA&T |
| Jagannathan Sankar | NCA&T |
| Debbie Kipp        | UNCG  |
| Debasish Kuila     | NCA&T |
| John Lepri         | UNCG  |
| Patti Reggio       | UNCG  |

- \* Will serve on the proposed Inter-University Coordinating Council



**APPENDIX A**  
**GATEWAY UNIVERSITY RESEARCH PARK**  
**A JOINT MILLENNIAL CAMPUS FOR UNCG AND NCA&T**  
**EXECUTIVE SUMMARY**

September 26, 2006

The basis for the creation of a joint NCA&T and UNCG Millennial Campus is to focus on the area's long-term future, including its economic development and overall quality of life. Our success will be dependent upon our ability to attract, establish, and/or retain effective educational and community service agencies and businesses driven by the discovery of new knowledge and technologies.

To achieve this vision, we will develop two campuses (North and South) that will provide significant physical resources (land and buildings) while enhancing the potential for a broad level of outreach and programmatic diversification. The North Campus will be just off U.S. 29 on the property formerly known as the Central North Carolina School for the Deaf (75 Acres with approximately 140,000 square feet of space in eight buildings). The South Campus will be on about 75 acres of the NCA&T Farm property, near the intersection of Interstate 40/85 and East Lee Street (currently undeveloped).

Early in the process of developing the concept of a Joint Millennial Campus, it was determined the most efficient mechanism for operating such a venture would be through the creation of a separate not-for-profit entity that would act as the management and development agent for the universities. Much of the work to form this new organization was completed during FY 2004-05 (i.e. bylaws, articles of incorporation, legal filings, etc.). Because of these efforts, the Gateway University Research Park was born.

We have devoted much of the past year and a half (FY 2005-06) establishing the operating parameters for the research park. Some of the more noteworthy accomplishments of the past year are as follows:

- Designer selection for Master Planning at the South Campus and Facility Assessment/Renovation Plan at the North Campus.
- A "draft" Strategic Direction Document was developed and will be further developed with the help of an expanded board of directors.
- Additional board members were identified and recruited to help guide the research park (terms to commence July 1, 2006).
- A Management Services and Development Agreement was developed and approved by both universities' Board of Trustees.
- A Ground Lease was developed and approved by the Gateway University Research Park Board, both universities' Board of Trustees, and the Board of Governors.
- We received a \$2 million appropriation for infrastructure design and construction, and additional renovations to existing facilities.
- A "Sole Source" agreement was reached with the USDA – Natural Resources Conservation Services for the construction of a facility to be located at the South Campus.
- A revised proposal was developed to pursue funding from the legislature (\$10 million) for the construction of an Interdisciplinary Research Facility (to be located at the South Campus) focused on nanotechnology, genetics, advanced materials, and clean energy technologies. The project was successful during the short-session and we are now working with facilities staff to develop a program for the facility.

In the upcoming year (FY 2006-07) we will be focused on finalizing many of the initiatives noted above with specific emphasis on starting renovations at the North Campus and "breaking ground" at the South Campus. Efforts are already underway to renovate one of the former classroom facilities at the North

Campus and the South Campus Master Plan was approved earlier this month. The Gateway University Research Park is working to begin construction as soon as possible.

Some of the other notable activities we hope to accomplish over the next twelve months are as follows:

- Approval of the Ground Lease (we are hopeful the ground lease will be on the November Agenda of the Council of State)
- A lease with the USDA should be completed by October 2006. The USDA is looking for 25,000 ± square feet. They currently have an M.O.U. in place at NCA&T and have recently begun working with researchers at UNCG in the area of GIS.
- Renovations to the classroom facility should be completed by June 30, 2007 and we should be prepared to welcome our first major tenant at the North Campus.
- With a completed master plan in place for the South Campus and a full assessment of the renovation needs at the North Campus, we should be well positioned to make recommendations for additional funding.
- Development of a Strategic Plan (focused specifically on action-oriented initiatives).

Should you have any questions, comments, or concerns, please feel free to call John R. Merrill, Executive Director of the Gateway University Research Park at (336) 375-9232 (or e-mail at [john-merrill@earthlink.net](mailto:john-merrill@earthlink.net)).