

**Request by the University of North Carolina at Greensboro to Establish
a Doctoral Degree Program in Nanoscience
A Program of the Joint School of Nanoscience and Nanoengineering**

Introduction

In June 2008, following recommendations from the Graduate Council and from General Administration, the Committee on Educational Planning, Policies, and Programs approved the request from the University of North Carolina at Greensboro and North Carolina Agricultural and Technical State University to plan a doctoral degree program in Nanoscience. The University of North Carolina at Greensboro now seeks approval to establish a doctoral degree program in Nanoscience (CIP: 40.9999).

Program Description

The proposed interdisciplinary doctoral program in Nanoscience is being established in conjunction with the Joint School of Nanoscience and Nanoengineering (JSNN), which has been established by the University of North Carolina at Greensboro (UNCG) and North Carolina A&T State University (NC A&T). This program will involve extensive collaborative effort among the faculty members of the two universities and the faculty members of the JSNN, and among the faculty members in the basic and applied sciences. The program is referred to as a *PhD in Nanoscience* to reflect its interdisciplinary nature.

This school and this program will position central North Carolina at the forefront of the next wave of innovation in basic research and technology. Explosive growth in fundamental research and development in this area impacts the science and engineering disciplines, and the commercialization of such research and development impacts many industries.

The proposed program is unique within the University of North Carolina for several reasons. The JSNN involves collaboration between two major universities with complementary strengths and histories. UNCG, the former Woman's College of the University of North Carolina, has a strong tradition in the liberal arts and has built considerable strength in the basic sciences. NC A&T is an Historically Black University with strong programs in the basic sciences and engineering. Both institutions are classified by the Carnegie Foundation of New York as "research universities with high research activity." The PhD program in Nanoscience (and the JSNN) will create a platform for interdisciplinary interactions among faculty members at JSNN and faculty members in more traditional programs at NC A&T and UNCG. Personnel with advanced training in nanoscience are in very short supply as described in *Challenges Facing Nanotechnology Exploitation* by C. O. Oriakhi: "The highly interdisciplinary nature of nanoscience and nanotechnology poses a significant challenge to academia, government, and industry. One of the immediate challenges facing companies developing nanotechnologies is assembling a team conversant with every aspect of nanoscale science and technology."

A primary feature of the program (and JSNN) is the interdisciplinary teaching and research on nanoscience in the nanobiological and nanoenvironmental science areas through an exploration of molecular structure, molecular function and dynamics, and their specific applications. The students will receive a solid background in nanoscience theory and experimental techniques through coursework designed to address the varied backgrounds of incoming students. Students are required to take a set of five courses in the Fundamentals of Nanoscience Course Sequence that introduces them to the theoretical underpinnings of nanoscience. A laboratory rotation through four laboratories is required in the first year in order to gain exposure to ongoing research activities, gain experience with laboratory techniques, and begin to choose a dissertation topic. Also a professional development seminar is required during the first year that will focus on important issues related to a career in research (e.g., grant writing, ethics, legal issues).

In the second and third years of the program, students take advanced elective courses in nanoscience areas to ensure that they will have substantial depth of understanding in their area of interest and to enable the student to effectively carry out advanced nanoscience research. After admission to candidacy for the doctoral degree, PhD dissertation research begins during the second year.

The PhD in Nanoscience will prepare students to take positions in industrial, governmental, or academic research settings.

UNC Tomorrow Relevance

It is a highly collaborative degree in a core STEM area that is designed to advance research in this new and rapidly developing field and to prepare graduates who can step into roles in business and industry in the state and nation.

Disciplinary Panels

Not applicable—previously approved for planning by the Committee on Educational Planning, Policies and Programs.

Program Review

The review process for requests to establish is designed to determine whether the proposal is developed to the stage appropriate for taking to the Graduate Council and if so what are the issues that may need further attention. Proposals to establish doctoral programs are reviewed internally and externally. The concerns from the reviewers were summarized in a letter to the Chancellors and Provosts prior to the presentation to the Graduate Council. That summary follows:

There was a focus on both curriculum and faculty in the reviewers' comments and a more general notion that while you may be ready to start up, the success of the program will require a lot of careful attention as it begins to develop, or as one reviewer puts it, a clearer mid-term strategy.

Issues are raised about the nature of this interdisciplinary program, such as how breadth and specialization are balanced in such a program.

The reviewers recommend constant attention to the curriculum since the field is so rapidly developing and the curriculum/research projects will need to stay abreast of those developments.

One reviewer thinks the curriculum may be too lecture course-oriented, and wondered if there may be ways to accommodate the different backgrounds/achievements of students before they come into the program. On the other hand, there does appear to be a need to have core content coverage to define the program.

One reviewer is concerned that the list of electives may lack coherence and suggests that an organization of the electives into areas of concentration might bring more coherence to the program and relate better to the dissertation research areas.

Both reviewers reiterate that the success of the program will ride on selecting and adding additional faculty.

While they are complimentary of the current faculty, they recommend that in order to be successful with larger collaborative grant proposals all the participants will have to document real prior research engagement in nanoscience.

One reviewer recommended that it would be important to make contact and develop a relationship with DOE's national user's facilities particularly for the benefit of students who may seek a non-academic track. It was also suggested that an industry/national laboratory advisory board be formed.

Both reviewers address the organization of the program and the need for the program to develop a clear identity, which the reviewers believe can be done even in the complex context of two universities.

It is always helpful to have a good account of the expectation in the contract and grant area and the support that will be available for graduate students in the program.

Graduate Council

The Graduate Council had, as a basis for its consideration, the proposal to establish the program, the summary letter to the Chancellors and Provosts, two external reviews, and a presentation to the Council by representatives of the program. Issues were raised about the curriculum, including the seven-week rotations in labs during the first year. Funding for the program was also questioned.

Response

Representatives of the program described the nature of the Joint School of Nanoscience and Nanoengineering formed by the two campuses. There was a recounting of the

funding to-date of the program. A building has been funded for more than \$50 million, and \$8 million for equipment has been provided. Groundbreaking for the building was in November 2009. The recurring operating budget is \$3.9 million funded by special state appropriations. These funds will be available to hire the start up faculty for the programs and provide support for graduate students in the program.

In an interdisciplinary program such as nanoscience it will be important to have balance between depth and breadth. The curriculum is designed to orient students to the breadth of the field but at the same time to involve students in cutting-edge research projects to prepare them for their dissertation work. The primary research areas will be nanobiology, nanometrology, nanocomposite materials, and bioelectronics.

The process of hiring faculty has begun and an early advertisement had over 90 responses.

The only other doctoral program with nanoscience in its title is the program in Nanoscale Science at the University of North Carolina at Charlotte.

Recommendation by the Graduate Council

After consideration of the issues raised by previous reviewers and Council members, the Graduate Council voted, without dissent, to recommend approval for the University of North Carolina at Greensboro to establish a doctoral program in Nanoscience.

Student Demand

While almost all scientific research is informed by nanoscience, there are still relatively few doctoral programs explicitly in nanoscience. For those that exist, the State University of New York at Albany typically gets over 150 applicants for 25 to 30 slots in its graduate program. Given the growing importance of the subject area, there will likely be a growing demand to have a degree in nanoscience. As one of the reviewers comments, "The nanobio focus of the proposed program taps into one of the fastest-growing pools of high-quality students pursuing graduate work." That reviewer reports that applications to nanoscience programs have grown five-fold in the past few years.

Opportunities for Graduates of the Program

This is a developing field and graduates of these programs will have a range of opportunities, especially in business and industry. One reviewer points out that there are five nanoscience centers located at the US Department of Energy and they are having difficulty finding enough trained scientists to meet their replacement and expansion needs.

Resource Implications

Resource Needs: This program will need a strong research faculty to establish the program and then it will need to attract a group of strong students to the program. It will need access to a wide range of scientific equipment for the research and training the program will provide. Fortunately the two campuses have extensive lists of equipment that complement each other.

Funding for the Program: The front funding of the Joint School (JSNN) will make it much easier to initiate this program. Recurring funding of \$3.9 million will allow the rapid building of a faculty, and the equipment funds will provide any needed equipment not already found on one of the campuses.

Estimated Cost to the State Based on the University Funding Formula: When the program is fully ramped up the program is estimated to generate approximately \$1 million in state appropriations.

Recommendation

The staff of General Administration recommends that the Board of Governors approve the request from the University of North Carolina at Greensboro to establish a doctoral degree program in Nanoscience.

Approved to be Recommended for Establishment to the Committee on Educational Planning, Policies, and Programs



Senior Vice President for Academic Affairs

December 15, 2009

General Information Template for Academic Program Review

Degree Area and Level:

PhD in Nanoscience (CIP 40.9999) at UNC Greensboro - Joint School of Nanoscience and Nanoengineering with NCA&T.

Addressing UNC Tomorrow:

Graduates of this program would possess the necessary skill set to enhance our global readiness (UNC Tomorrow Recommendation, 4.1 and 4.1.2) in developing 21st Century skills while enhancing global competitiveness. Furthermore, the degree program is offered at the Joint School of Nanoscience and Nanoengineering (NCA&T and UNCG) and is an example of promoting increased partnerships between UNC campuses (UNC Tomorrow Recommendation, 4.1.3).

Role of Program in Relation to State and Regional Needs:

It is predicted that advances in nanoscience and nanotechnology will impact all aspects of human experience including but not limited to healthcare and medicine, IT, transportation, electronics, defense, communication, entertainment, and environmental sustainability. In April 2006, *A Roadmap for Nanotechnology in North Carolina's 21st Century Economy* was released by the Governor's Task Force on Nanotechnology and the North Carolina's Economy. The report states that, "North Carolina ranks among leading states in the quality of its nanotechnology research base. The state has at least 40 companies actively working with nanotechnology; these companies range from small, relatively new startups using nanotechnology as a core part of their manufacturing processes, to large, well-established firms that use nanotechnology in their existing operations." One of the 10 action items contained in the Report stated that, "The North Carolina Department of Public Instruction, the North Carolina Community College System, and the state's colleges and universities must ensure that nanotechnology-related modules are explicitly included in science education curricula at all levels."

http://www.ncnanotechnology.com/public/_assets/NCNanotechTaskForceReportFinal.pdf

US Labor Department Analysis:

- *Summary* – The Occupational Supply Demand System puts this degree program in a broad category of Physical Sciences and they do not provide a narrative for this cluster.

Availability of Program Statewide (Enrollment and Degrees Awarded in Last 3 Years)

- *Public universities* – The following degree program was approved for establishment on 1/12/2007. There are not yet any graduates.

Enrollment			Academic Year		
			Fall 07	Spr 08	Fall 08
UNC-C	Nanoscale Science	PhD	10	10	13

- *Private universities* - Not available.

Available or not from Academic Common Market:

Not available

UNC Greensboro Campus enrollment and degrees awarded in similar programs at the Doctoral level:
(Based on two CIP digits – 40 CIP is the summary group for Physical Sciences under which Nanoscience is listed as a program)

UNC Greensboro does not offer a Doctoral program in the 40 CIP category.

Campus Average of enrollment and degrees awarded in this degree area at the Doctoral level:
(Based on two CIP digits – 40 CIP is the summary group for Physical Sciences under which Nanoscience is listed as a program - over the last 3 Academic Years, Fall 2005-Fall 2008)

Campus Average			
	Number of Active Programs	Enrollment per Semester	Degrees Awarded per Year
NCSU	3	85	11
UNC-C	2	20	2
UNC-CH	4	80	12
Campus Average		62	8

UNCG Campus Degree Programs added in the past three years:

- *Bachelor*
 - N/A
- *Master*
 - MSAT Athletic Training (06/08/2007)
- *Doctoral*
 - PhD Medicinal Biochemistry (01/11/2008)
 - PhD Computational Mathematics (01/11/2008)
 - PhD Communications Sciences and Disorders (01/12/2007)

UNCG Degree Programs discontinued in past three years:

- *Bachelor*
 - BS Dance Education (03/16/2007)
 - BA German, Secondary Education (03/20/2009)
- *Master*
 - N/A
- *Doctoral*
 - N/A