

## APPENDIX 2: CORNELL UNIVERSITY/NATIONAL NANOTECHNOLOGY INFRASTRUCTURE NETWORK PROFILE

### I. Description

**Institution:** Cornell University (with 12 other sites)

**PI:** Sandip Tiwari

**Co-PIs:** none

**Title:** National Nanotechnology Infrastructure Network

**Proposal:** 0335765

**Program Officer:** Larry Goldberg

**Education Outreach Director (name and email address):** Nancy Healy, nancy.healy@mirc.gatech.edu

### II. Research Agenda

**Research Focus:** NNIN is not a research organization and is not directly funded for research

The National Nanotechnology Infrastructure Network (NNIN) is an NSF-funded partnership of 13 university user facilities openly available for research and development in nanoscience. We provide the tools and training to support the nanotechnology research needs of researchers in academic, industry, and government.

### III. Education Activities within the University

NNIN has as its goals a wide variety of educational outreach that spans the spectrum of K-gray, i.e. school aged children through adult professionals. Education and outreach components of the NNIN include network-wide programs to address needs at the national scale and more specific efforts for communities that are local to network sites. This report will highlight activities occurring across the network and will serve as examples but will not encompass all activities occurring.

Our activities focus on the following general areas:

- ◆ Activities to encourage K-12 students to enter STEM
- ◆ Resources to inform the public
- ◆ Activities and/or information to undergraduates on careers in nanoscience
- ◆ Tools and resources for undergraduates and graduate students (teaching and learning focus and research focus)
- ◆ Outreach programs for under-represented groups
- ◆ Technical workforce development
- ◆ Activities and/or resources for K-12 teachers and guidance counselors

The 13 NNIN sites each have responsibility for specific components of our education agenda. Certain sites are also lead institutions for an outreach activity and will work in collaboration with other sites. For example,

the University of New Mexico is the lead site for addressing under-represented groups but this work is in collaboration with Georgia Tech, UC Santa Barbara, and Howard University. However, all sites will utilize materials and resources that this group develops.

The NNIN education and outreach programs are typically designed to begin as local programs at each host institution and then expand to the other sites and eventually be posted on the NNIN web site for national dissemination. Because the NNIN is a national network of 13 universities, it is difficult to divide out activities between inside and outside the university. This report will describe activities occurring across our network and thus combines sections III and IV.

### **Description of activities**

- ◆ NNIN education portal [http://www.nnin.org/nnin\\_edu.html](http://www.nnin.org/nnin_edu.html)
- ◆ NNIN social and ethical issues portal <http://sei.nnin.org>
- ◆ Summer camps for high school students
- ◆ K-12 outreach programs (on-campus tours, activities, and on-site school programs, including a traveling NanoVan)
- ◆ Research experiences for high school students
- ◆ High school brochure on entering STEM and nano fields
- ◆ PSAa for middle and high school audiences at Howard University
- ◆ Science magazine for children <http://nanooze.org>
- ◆ REU program (81 participants in 2005 at 12 sites) with end-of-program convocation which is a “mini” scientific conference that is webcast ([http://www.nnin.org/nnin\\_reu.html](http://www.nnin.org/nnin_reu.html))
- ◆ RET program at Stanford, Georgia Tech, and Univ. of Washington (local programs which vary in design at each site)
- ◆ Teacher workshops at Penn State Univ.
- ◆ Exhibitors booth at NSTA
- ◆ Instructional materials development (UC Santa Barbara and Penn State have completed materials and Georgia Tech is beginning development); Stanford has an IMD award from NSF with McRel to develop high school materials under a project titled “A Nano Leap into New Science”
- ◆ Guidance counselor brochure under development at Univ. of Washington
- ◆ Workforce development
  - ◇ Penn State and U. of Minnesota have two year college partnership programs in nanotechnology
  - ◇ UCSB offers six-month internship program for community colleges
  - ◇ Univ. of Texas nine-month internship in microelectronics and nanotechnology for community college students
  - ◇ Univ. of Washington’s Ph.D. nanotechnology option (expansion under NNIN through support and training at facility)
  - ◇ Workshops held at sites on a variety of topics such as characterization, fabrication, research, and product development (<http://www.nnin.org> for upcoming and past events)

- ◆ Course development
  - ◇ Web-cast MEMs course from the Univ. of Michigan
  - ◇ Nano-ethics course at Univ. of New Mexico
  - ◇ On-line open textbook on nanotechnology (Univ. of Minnesota lead organizer) currently under development
- ◆ Nanotechnology graduate student organizations at Univ. of Washington and Georgia Tech.
- ◆ Two special symposia:
  - ◇ MRS Spring 2006 three day session on NanoEducation
  - ◇ AAAS February 2006 session on formal and informal education (NNIN with NISE-NET)
- ◆ Outreach materials at professional organizations conferences of under-represented groups
  - ◇ University of New Mexico developing recruitment brochure

### **Program staff and expertise**

Each site's program staff varies in terms of expertise. The NNIN Education Office is housed at Georgia Institute of Technology which coordinates the NNIN education efforts across all 13 sites and with other national programs. Some sites have full-time education coordinators while others have a part-time person (time commitment varies for part-time personnel). The NNIN education coordinators meet twice each year at various sites and an additional two times by teleconference.

### **Goals and objectives**

The NNIN has established the following goals for its network-based educational outreach and training:

- ◆ Expose young people to advanced and exciting research in nanotechnology and motivate them to educate themselves for careers in the sciences or engineering;
- ◆ Train teachers and guidance counselors about the discipline of experimental sciences, provide additional teaching tools, and enhance their enthusiasm for having students pursue careers in science;
- ◆ Create and distribute educational materials for children, college students, technical professionals, teachers and the general population, as well as improve the understanding of and involvement with science, technology, engineering and mathematics;
- ◆ Focus these efforts on population segments having disproportionately low employment and education in sciences, including women, disadvantaged minorities, and the economically disadvantaged.

### **Target audience (educational levels, number of students at each level, etc.)**

The target audience for NNIN activities is K-gray which includes elementary school students through adults (graduate students, faculty, adult professionals, and the general public)

### **Current activities**

NNIN has developed and anticipates continuing development of instructional materials for K-12 schools and teachers. In addition there will be course development for undergraduate and graduate students and adult professionals. We are also developing materials (print and media) to encourage high school students to consider careers in STEM and in particular nano. These efforts also have a focus on reaching under-represented populations. Our web site will also contain information on activities that can be done during school visits to nanotechnology research sites as well as demonstrations suitable for visits to schools.

**Nano S&E content focus** The NNIN also focuses on social and ethical issues of nanotechnology. The SEI portal has numerous resources available <http://sei.nnin.org>. Each site has an SEI coordinator with lead SEI sites being Cornell, Univ. of Washington, Univ. of New Mexico, Stanford, and Georgia Tech. The SEI programs are coordinated by the Cornell University site. Below is a summary of current SEI activities:

- ◆ SEI portal developed at NNIN web site
- ◆ REU participant developed training video in SEI; all REU students participated in REU activities at their sites and at the convocation
- ◆ An analysis of public awareness and perceptions of nanotechnology, particularly as it relates to public health
- ◆ Georgia Tech is examining how nanotechnology enters commercial markets
- ◆ Development of a nano-ethics course at Univ. of New Mexico
- ◆ Survey of nano-researchers on ethical issues
- ◆ Univ. of Washington is examining how nano-researchers communicate their work and what ethical issues they face.
- ◆ Cornell Univ. is examining the laboratory life as it pertains to research and development of nanotechnology
- ◆ Co-sponsoring of workshops and symposia
  - ◇ AAAS February 2006 session on SEI issues

## V. Education Outreach Materials

**Describe and provide examples of materials, outlines, demonstrations, etc. developed for outreach activities for the K-12 and/or informal audiences**

**Examples of some of NNIN efforts:**

- ◆ The NNIN education portal has information on several topics suitable for K-12 students including our science magazine *Nanooze*. Additional materials for the web site are under development
- ◆ We have instructional materials developed and under development that will soon be posted on the web site. For example, Penn State has developed a NanoProducts lesson that can be used with visiting school groups, by teachers, and community organizations. They are also beta testing high school chemistry units that have a nanotechnology theme. Additional units are being developed in physics and biology.
- ◆ Lessons developed by RET teachers are under revision and will be posted on the site once edited.
- ◆ Georgia Tech has developed a tour/demonstration program for school groups and is modifying it so that other sites can use the model. This will be posted on the web site.
- ◆ The on-line Open Textbook in Nanotechnology will be available to anyone through our web site. It is due for completion within the next year.
- ◆ Promotional materials targeting high school students and undergraduates are under development and will be distributed to schools, at conferences, and be posted on the web site.

### **Describe a recent successful education outreach activity**

The NNIN 2005 REU program hosted 81 students at 12 sites. These students performed hands-on research in nanotechnology using our state-of-the-art facilities. Our program received 500 applications from across the nation. Survey results of our participants indicate that 31% applied only to our program and another 15% to only one other REU program. Because of the diversity of our sites (in terms of research focus and equipment) we offer students a wide variety of research projects that allow them to see the breadth of nanotechnology and to gain an understanding of the interdisciplinary nature of nanotechnology. The NNIN REU program culminates with a convocation where students present their results in both oral and poster format. Students learn about research conducted by their peers at other sites and have a time to network with their peers. Our survey results indicate a high level of satisfaction with the program and that the convocation is an important professional experience for the participants. Student presentations can be viewed at [http://www.nnin.org/nnin\\_reu.html](http://www.nnin.org/nnin_reu.html).

## **VI. Education Outreach Evaluation**

### **Summarize outreach evaluation plan**

Individual activities have their own survey instruments to determine success of a program. For example, Georgia Tech's NanoCamp surveys their participants at the end of the camp to determine satisfaction/non-satisfaction with the numerous activities during the week long program. Other sites do similar survey. In addition, through our communication network, sites share survey instruments which than can be adapted for each sites programs.

The NNIN is also developing a data management system for collecting evaluation data on our numerous programs. Our system will collect information on the outreach activities occurring at all levels and will include typical information on type of activity, number of participants, demographics of participants, and survey results.

## **VII. Lessons Learned**

### **List 2-3 lessons learned to share with others embarking on a nano education outreach effort.**

If you are a multi-site program, it is imperative that you get to know your counterparts at the different sites. It will make communication go a lot easier.

If you are a multi-site program, it is imperative that you establish a communication system for regular communication among and between sites.

Teachers are interested in nano but don't know where it fits into the curriculum. They are also interested in all level of nano instructional materials from short little introductions/"fillers" to full scale lesson tied to the standards.

