NNCI – Education and Outreach

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GEORGIA INSTITUTE OF TECHNOLOGY
SOUTHEASTERN NANOTECHNOLOGY INFRASTRUCTURE CORRIDOR
NNCI E&O as proposed

- Diverse set of programs proposed by 16 sites and 27 institutions
- The proposed coordinating site will be tasked to develop an integrated program that will reach all levels of the population
- Will differ from NNIN E&O
  - Networked program
  - Local and national programs
  - Accomplishments
NNIN – accomplishments in E&O
NNIN E&O

E&O program was located at GT’s Institute for Electronics and Nanotechnology

- Supported by 2 staff
- Most sites had a full or part time coordinator
- Directly reached >60,000 in 2014
- 2004-2015: >350,000
NNIN Education & Outreach Mission

• Offer education and training to address the growing need for a skilled workforce and informed public
• Provide resources, programs, and materials to enhance knowledge of nanotechnology and its application to real-world issues
• Believe that a strong US economy requires a STEM-literate workforce ready to meet the technological challenges of a nano-enabled economy as well as an informed citizenry that supports continued and safe growth of nanotechnologies.
Scale of NNIN E&O programs - Educate a dynamic workforce

Scale of programs – from individuals to groups

- Focused training – undergrad, grad, and other professionals
- Larger groups – workshops, symposia, outreach
- Nation and beyond – nano-ed materials, training videos, courses, web, Nanooze
National and Local Activities

Two-pronged approach for education and outreach

- Programs & activities across network – national reach
- Programs & activities that address local needs and interest

NNIN used the synergy from local and national programs to develop and maintain high quality education outreach that met the needs of diverse groups.
NNIN Education Programs by Audience

- **K-12 Students**
  - Camps
  - NanoExpress
  - Nanooze
  - Nanodays
  - USA Festival
  - Outreach

- **Teachers**
  - Workshops
  - Activities
  - NanoTeach
  - RET

- **Undergraduates**
  - REU
  - iREU

- **Graduates**
  - iWSG
  - iREG
  - Workshops
  - Symposia

- **Professionals**
  - Symposia
  - Workshops

- **Community**
  - Nanodays
  - USA Festival
  - Community events

- **Diversity**
  - LEF
  - Showcase
Research Experience for Undergraduates - Network Program

- Effective because of network cooperation
- Network offered breadth of projects and visibility
- Best practices shared among sites
- Network-wide **expectations**
- Ten weeks – research, convocation, *Research Accomplishments*

70-85 interns/year
Minimum 5/site
Longitudinal Tracking Study

- In 2007, began a formal program study of all NNIN/NNUN students who had been out of the program for 4 or more years.
  - 1997 - 2010
  - 2011 began this fall
- Response from 613 of 815 participants in the target years (~75%).
- Brief Survey Monkey “check-in” – link on NNIN home page
  - Solicited by email
Longitudinal Study

Education paths of participants

- PhD: 51%
- MS: 25%
- BS: 16%
- Others: 3%
- Stopped with BS/BA: 1%
- Completed or working on terminal Master's degree: 4%
- Completed or working on Ph.D.: 3%
- Completed or working on law degree: 1%
- Completed or working on M.D. or other medical degree: 4%
- Other (MBA, etc.): 1%

Comparative data from Science and Engineering Indicators 2012 (2000-2009)

<table>
<thead>
<tr>
<th>Education Path</th>
<th>Percentage</th>
</tr>
</thead>
<tbody>
<tr>
<td>Baccalaureate to Master's</td>
<td>~21-22%</td>
</tr>
<tr>
<td>Baccalaureate to Ph.D.</td>
<td>~7 – 8%</td>
</tr>
</tbody>
</table>

Did the program influence you (or reinforce your choice) to pursue education or a research career in science, mathematics, engineering, or technology?

- YES, influenced me to pursue/continue to pursue a Science/technology research career: 72%
- Influenced me to NOT SEEK a science/technology RESEARCH career: 14%
- Influence me to NOT SEEK any type of science/technology career: 7%
- Did not influence my career choice significantly: 7%
- Other (please specify): 0%
## Longitudinal Study

<table>
<thead>
<tr>
<th>NNIN REU Longitudinal Study N=615</th>
<th>NNIN REU Longitudinal Study Women</th>
<th>NNIN REU Longitudinal Study Minorities</th>
</tr>
</thead>
<tbody>
<tr>
<td>Academic Path</td>
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</tr>
<tr>
<td>Baccalaureate</td>
<td>1997-2010</td>
<td>1997-2010</td>
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<tr>
<td>Master’s</td>
<td>16%</td>
<td>Baccalaureate</td>
</tr>
<tr>
<td>Doctorate</td>
<td>25%</td>
<td>Master’s</td>
</tr>
<tr>
<td>M.D./J.D./M.B.A</td>
<td>52%</td>
<td>Doctorate</td>
</tr>
<tr>
<td></td>
<td>7%</td>
<td>M.D./J.D./M.B.A</td>
</tr>
</tbody>
</table>

| Academic Path                    | 1997-2010                         | M.D./J.D./M.B.A                        |
| Baccalaureate                    | 18%                               | 8%                                     |
| Master’s                         | 26%                               | 8%                                     |
| Doctorate                        | 48%                               | 8%                                     |
| M.D./J.D./M.B.A                  | 7%                                | 8%                                     |

| Academic Path                    | 1997-2010                         | M.D./J.D./M.B.A                        |
| Baccalaureate                    | 19%                               | 8%                                     |
| Master’s                         | 31%                               | 8%                                     |
| Doctorate                        | 42%                               | 8%                                     |
| M.D./J.D./M.B.A                  | 7%                                | 8%                                     |
Career Outcomes

Does your current position involve science or engineering?
- YES: 93.6%
- NO: 6.4%

Does your current position involve nanotechnology? (broadly defined)
- YES: 51%
- NO: 49%

N=613/815
International REU

**International Partners**

- National Institute of Materials Science; Tsukuba, Japan (not 2011)
- Forschungszentrum, Helmutz Research Center; Jülich, Germany
- IMEC Leuven, Belgium
- Technical University of Delft, The Netherlands
- Ecole Nationale Supérieure des Mines de Saint Etienne; Gardanne, France

**2nd year high quality experience in NSE research**

**Encourage & support promising students in STEM pipeline**

**Developing future STEM leaders with global awareness**
NNIN iREU – Participant Outcomes

NNIN iREU
109 participants
2008 - 2015

Non-academic (currently)
Currently in Graduate School

Undergraduates

Graduate School
68
- Berkeley
- Carnegie Mellon
- Georgia Tech
- Stanford
- UCSB
- UCSD
- U. Colorado
- U. Chicago
- U. Minnesota
- U. Michigan
- Columbia
- Case Western
- Penn State
- Cambridge
- Mayo Graduate School
- Iowa State U.
- MIT
- UCLA
- Ohio State
- Duke
- Northwestern
- U. Washington

Graduated Ph.D. 2

Employment 20

Still Undergraduates 19

NSF Fellowships 29 awarded and 9 honorable mentions (to date)
NNIN Research Experience for Teachers

NSF Awards
2006
2009
2012
2006-2012 – 5 NNIN sites
2012-2015 – 4 NNIN sites

~15-20 participants/year
NSE research projects
Classroom modules to Ed Portal
(90% RET)

8 week program
2006-2012 - NSTA event
2012-2015 - NNIN Workshop

2006-2011: 169 total – 49% males; 51% females; 37% underrepresented; 67% taught in schools with high proportion of underrepresented students

NSF # EEC-0908895
Teacher Professional Development

- Local, regional, and national workshops
- Duration: 2 hours to one week
- Connecting NSE to K-12 science curriculum
- Addressing science standards using the big ideas of NSE
Teacher Workshops
NNIN Education Portal

- General Information
- User Training Videos
- Multimedia resources
- K-12 Resources (teacher/student)
- Nanooze

- K-12 Students
- K-12 Teachers
- Undergrads
- Graduates & Professionals
- Community
- All Technology Articles
Curriculum Materials

90% written by RET participants
- **Nanooze**, the Web site
  - English, Spanish & Portuguese

- **Nanooze**, in print
  - Since 2008
  - Free to teachers
  - 1MA in print

- **Nanooze** the exhibit
  - Disneyworld – Epcot
  - Disneyland - Tomorrowland

*Prof. Carl Batt, Cornell*
Workshops and Symposia

- **Education & Workforce**: Introduce NNIN capabilities to potential users.
- **Undergrads, graduate students, post-docs, faculty, industry, government**: Help define new directions for network in developing areas of nanoscience.

Multiple Duties/Multiple Audiences
NNCI E&O from RFP

- Innovative educational experiences infused with content from the frontiers of nanoscale science and engineering research for graduate and undergraduate students, postdoctoral associates, and others

- Educational experiences may include REU and RET, domestic and/or international

- Development of instructional modules for incorporation into undergraduate curricula, and other novel educational resources and tools

- Educational outreach and workforce development plans

- Diversity and broadening participation: among students, faculty, staff, management, and outreach activities

- Outreach plans to increase the external user base: to encourage non-traditional users from diverse communities, and to reach potential users from startups and small businesses

- How the site may complement and connect to other local resources, such as business incubators, prototyping and manufacturing facilities

- Innovative strategies to disseminate effective practices and knowledge to the broader research, education, and technology communities
NNCI E&O

- 16 sites with 16 individual E&O programs proposed
- Common themes across the site programs which will lend themselves to collaboration and support
- New innovative programs that will target researchers, community colleges, MSIs and URMs, the general public and K-12 students
NNCI E&O

- 10 - 11 of the 16 sites will have a Research Experience for Undergraduates program
  - There will NOT be a network-wide program
    - Students should check individual NNCI sites for REU program information until the coordinating office is chosen.

- K-12 teachers
  - Three sites will have an RET program
    - Northwestern, UC San Diego, and Arizona State
    - University of Washington will have an educator in residence.
  - Three sites will offer teacher professional development
    - University of Nebraska, Montana State, and Georgia Tech
NNCI E&O

- Community & Technical Colleges
  - Seven sites will work with community colleges
    - U. Penn, Georgia Tech, Virginia Tech, NCSU, ASU, UCSD, Harvard
  - Two sites have community colleges as their partners
    - U. Penn and Arizona State
- Focused on workforce development
  - Curriculum support
  - Cleanroom training
  - Internships
  - Summer Nanotechnology workshop – NCSU
  - Online training – Virginia Tech
  - Remote SEM access - ASU
  - Research Experience for Veterans - Harvard with Bunker Hill CC
NNCI E&O

Underrepresented scientists and engineers

- UT – directed outreach to HSIs
- Northwestern – outreach to Chicago schools and museums
  - URM and women
- Virginia Tech – funding for MSI students to use facilities
  - African-American and Latino students from Howard and Georgia State
- Stanford
  - Two MSI Cal State colleges – coursework, hands-on training
- Cornell
  - User outreach to MSIs
- Nebraska
  - Conference on Women in Physical Science, Upward Bound, after school programs
- U. of Kentucky
  - Seed research programs for URMs
- ASU
  - Remote SEM to tribal schools
- Harvard
  - Scholars Program for URM grad students, post-docs, and young faculty
NNCI E&O

K-12 outreach
- Programs designed for middle and high school students
- Afterschool and summer programs
- K-12 schools use NCSU facilities for free
- Outreach to elementary schools
- Nanooze – website and magazine from Cornell
- Remote access of facilities
- Online training workshops

Public
- STEM events
- Museums
- Pulse on the Planet – radio broadcasts from VT
- NanoJournalism at Northwestern
- Community groups
- Science festivals
NNCI E&O

Undergraduate, graduate students, post-docs, other users

- Stanford
  - Document & disseminate process flows/protocols
  - Student program to develop and document new processes
- Technical workshops and courses – most sites
- Entrepreneurship
  - ASU support of student for certificate program
  - Entrepreneur in residence at UW
  - iCorps plus and professional development program for grad students and post-docs at Georgia Tech
- MOOC on nanotechnology – NCSU
Social and Ethical Issues of Nanotechnology

- Six sites will include
  - ASU, UT, GT, Montana State, Northwestern, NCSU
- ASU
  - SEI user facility for training researchers
  - Science Outside the Lab – two week policy experience in Washington, DC
  - SEI training of users
- UT
  - Research study examining SEI implications of nano with nanoscientists
    - In collaboration with UT College of Communication
- GT
  - I Corps plus – SEI module
  - SEI workshops and training
NNCI E&O

SEI
- Montana State
  - on-site and web-based instructional and outreach activities related to the ethics and societal impacts of nanotechnology
- Northwestern
  - Science in Society program
  - SEI outreach through NanoJournalism
    - In collaboration with the Medill School of Journalism
- NCSU
  - SEI research program
  - Assessment and evaluation of programs through SEI team
NNCI E&O

- NNCI E&O promises to impact all levels of society
- New and innovative programs have been proposed
- Some carryover of programs from NNIN
- Once coordination site selected more information on the programs will be available on the NNCI website

Thank You!