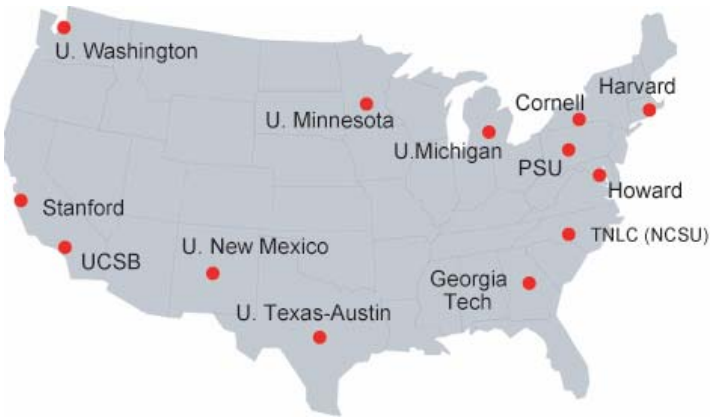
National Nanotechnology Infrastructure Network: Users & Diversity

DMR Facilities Directors' Meeting
Sept 20, 2007



Sandip Tiwari
Director

NNIN Facility User and Usage

- Thirteen cooperating sites operating open, hands-on user facilities
- Complementary facilities; most users make structures, devices, and systems for exploration across the breadth of nanotechnology areas
- High level of individual staff support and instruction
- New users accepted every week; 1000+ new users per year

- First contact: phone, web or e-mail
- Discuss project with NNIN staff experts
  - Redirection to alternative site if appropriate
- Consult web resources (process libraries)
- On line training
- *2 page maximum* technical description of proposed work
- Visit Site for hands on training and user support
  - Safety training and ethics tutorial
  - Consultation and support
  - Timely equipment training
  - Fabrication and characterization
- Evolve to independent user
- Local low-cost housing for users

From first contact to first visit: Two Weeks

Visit Duration: From 1 week to months

Low Barriers to Entry

Useful structures by the end of first visit

Counting Users

A user is a unique person using the facilities over a period of one year.

NNIN activities require staff, integration, training, … - large infrastructure support; user numbers provides an incomplete view of effort, demand, and impact

Diverse data collection from network sites for use, intensity, demand, type and impact. of use. Our focus is on the external user support from the facilities.

Primary Metrics

- **External usage**
- Cumulative Users
- Average Monthly Users
- Lab Time
- User Fees
- Publications
- Highlights
- …

Secondary Metrics

Computed from primary *metrics*

- External hours/user
- User fees per user
- Fees per hour
- Area resource requirements
- …

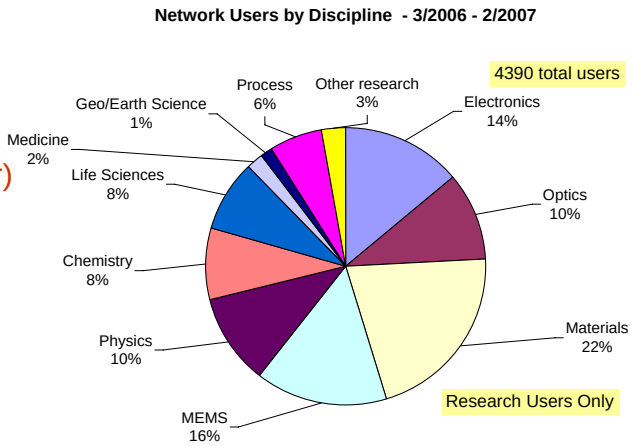
Primary Metric Data submitted by Sites monthly

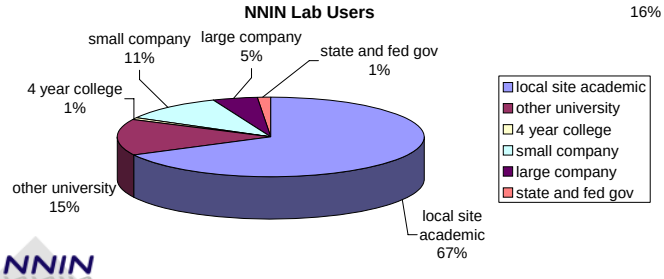
Broken Down By

- All Users
- Outside Users
- Outside Academic Users
- Technical Area
- Site
- Combinations of above

Users and Disciplines

2006-07:
3500/year Graduate Students
(>1000 PhD awards/year)
>250 Companies
(683 Industrial Users)
>1600 publications





Diversity

- Diversity of NNIN users reflects the diversity of graduate student enrollment in science and engineering across the US and employment in industry
- Users and broader outreach
  - Low academic fees, training and staff support is how NNIN serves
  - We do not have funding leverage with external users, constrained influence on the external user graduate admission or faculty hiring
  - We serve users and conduct activities of broader outreach in support of promotion
  - We do have local influence, i.e. at our institutions
  - And we have national and geographic outreach that we can leverage
- NNIN concentrates locally and externally through active and promotion activities towards diversity
  - Pipeline issues, providing leverage for increasing diversity, and unique programs that take advantage of our local and national presence and resources
  - Research activity support
  - Our activities are across the spectrum
    - K-12, undergraduate, graduate, teachers, faculty, …

Context

- 1 of 12 Directors Female
- 1 of 12 Directors Under-Represented Minority
- 1 of 11 Advisory Board Members Female
- 1 of 11 Advisory Board Members Under-Represented Minority
- 25% of NNIN Staff is Female
- 9% of NNIN Staff is Under-Represented Minority

- Many of the advisory board members, who are seniors from industry and academia, have participated in academy, foundations, and other national studies devoted to increased science and engineering interest on the part of all and specially in diversity/inner city/…
  - Activities that we pursue are from science and engineering educator and practitioner perspective and major activities are vetted by our board
    - Students, faculty, school teachers, school students, visiting children, … love what we do

Diversity within our Universities

- All major research universities are focused on diversity
  - Examples: Cornell, Stanford, GaTech, UMich, (all) … have goals similar to Cornell's … 20%F, 7% URM … in engineering and programs in place … Advance, … to help work towards these
  - NNIN sites are a tremendous asset in making a stronger case for the university that provide additional support to university initiatives
  - Faculty hiring is highly competitive

- Within NNIN, we do have limitations – opportunities for hiring are very limited
  - When these arise, across the range of positions, there is strong focus on diversity and to openness of experiences and opportunities
  - We focus on local and national support through our programs and practices

Some NNIN Broader Activities

- Outreach to communities around us are both national and local
  - "Nanooze" our children's magazine is accessed through web and is distributed in paper form upon request
    - Numerous requests for school visits come from this and the NNIN sites respond
  - REU program
  - RET program
  - Symposiums and special day-long hands-on teach-ins
- Local activities focus on local environment
  - City-based facilities focus on inner-city needs
    - Local programs, many, including "NanoExpress"
    - Collaborative programs with community colleges
  - Geographic vicinity programs
    - Chip Camps (3 day, week to month long)
    - Collaborative programs with Community Colleges, Native American, Hispanic, … emphasis

NNIN REU Program

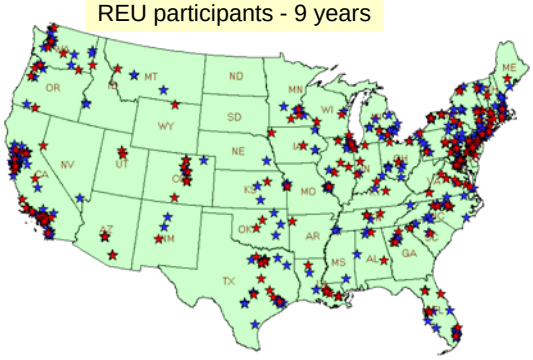
- The NNIN Research Experience for Undergraduates program is a highly successful network-wide experimental nanotechnology research program
  - Highly regarded by participants, faculty, and invited evaluators, and a compelling experimental emphasis
- 12 year history (as NNUN and NNIN)
  - Over 500 cumulative participants

Participation
23% Minorities
42% Female

NNIN REU Program Summary

- Large, highly visible and very competitive
- 10 week intensive program
- Infrastructure and procedures in place to efficiently handle
  - 300-500 applications
  - 50-80 participants per year
- Procedures and policies to manage 50-80 projects while delivering a reasonably consistent, quality research experience
- End of program convocation and published Research Accomplishments
- Excellent participation from women, minorities and smaller institutions

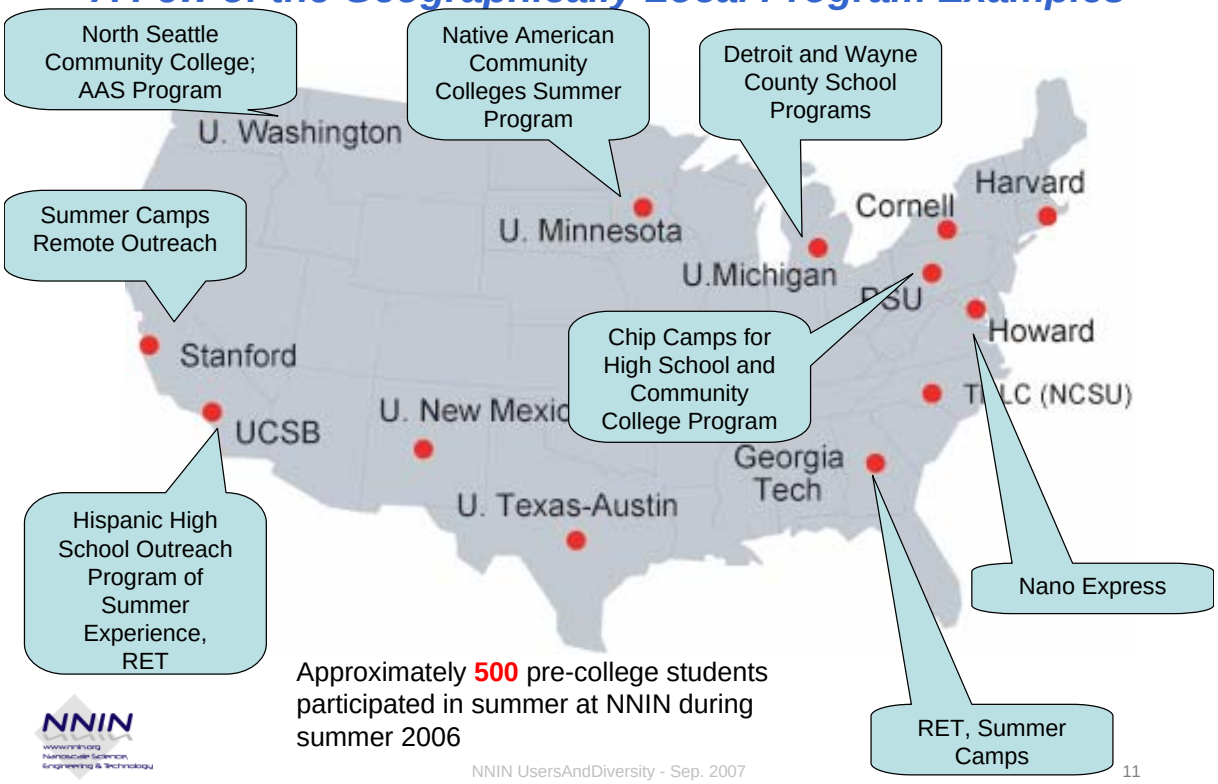
REU participants - 9 years



Longitudinal studies of our program:
46% PhDs, 88% science career
% of applicants going to PhD increasing

A large proportion of these students go to graduate school; a good fraction of them at NNIN schools

A Few of the Geographically Local Program Examples



Approximately **500** pre-college students participated in summer at NNIN during summer 2006

NanoExpress (Howard University)

Launched in fall 2006, the NanoExpress is a mobile laboratory. Experimental areas for visitors to explore nanotechnology – nanoparticles, micro/nano-fabrication, instrumentation, self-assembly, & characterization. Visits primarily schools, but also teacher/professional conferences, etc.

NNIN Education: Nanooze

Children's Magazine

www.nanooze.org

Fun and excitement of science

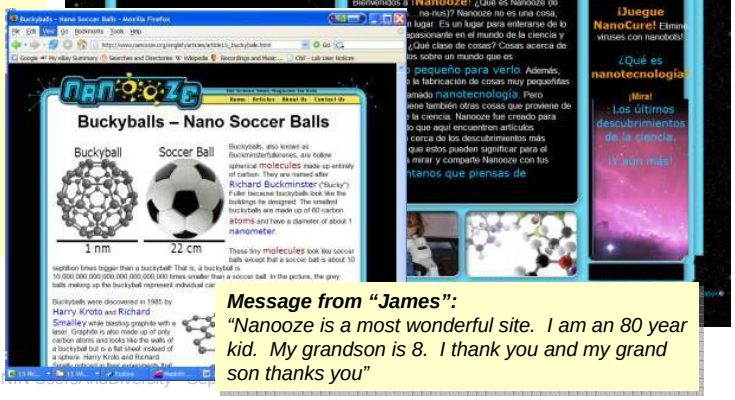
- Primer on nanotechnology
- Informal, kid-friendly style
- Original articles
- Interviews
- Also in Spanish and Portuguese

- Post cards distributed to teachers at conferences

A fun resource that teachers explore with students

English

Espanol



Message from "James":
"Nanooze is a most wonderful site. I am an 80 year kid. My grandson is 8. I thank you and my grand son thanks you"

Nanooze and FIRST Lego League

- FIRST Lego League (not NNIN affiliated)
  - ♦
- 200
  - ♦
- "sci
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- Nanooze was listed as a technical reference @ firstlego.com

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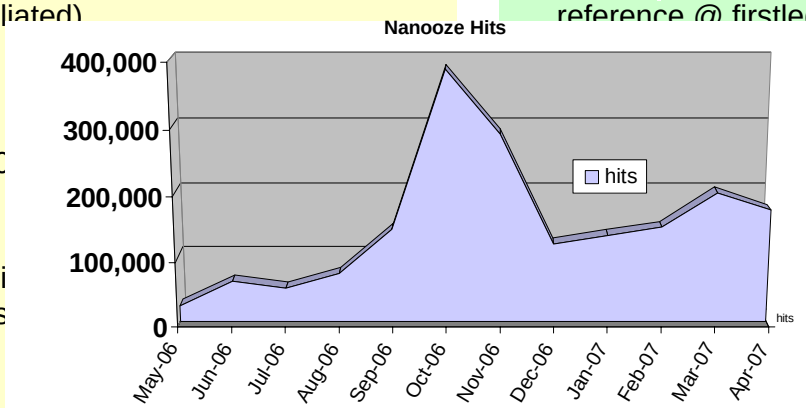


- Locally, many sites have held workshops/open houses related to the First Lego Event
- > 1600 attendees

Nanooze is now in print and selectively distributed

Numerous visits to high schools initiated through queries

NNIN Diversity Activities: Nanotechnology Symposiums

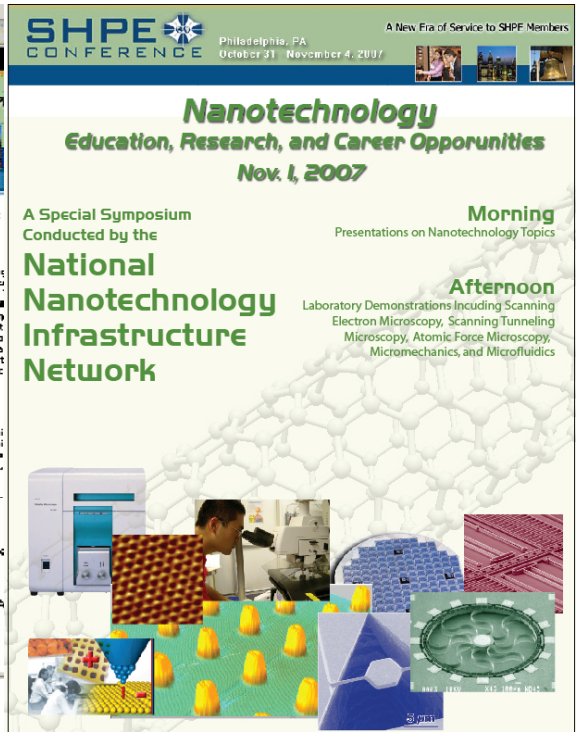
- Introduction to Nanotechnology
- Directed to minority and underrepresented undergraduates via major minority serving professional engineering societies
  - Society of Hispanic Professional Engineers, Nov. 1, 2007
  - Also at SWE, and NSBE
- Goals
  - Nanotechnology career awareness
  - Appropriate education for entry into nanotechnology career track
  - Increase pipeline of minority nanotechnology students.
    - Terminal undergraduate
    - Graduate
  - Long term effect on NNIN user base

- Lectures (morning)
  - What is Nanotechnology
  - Nanotechnology concepts and applications
  - Nanotechnology tools
  - Nanotechnology careers
  - Nanotechnology education
  - Undergraduate nanotechnology research opportunities
- Laboratory activities (afternoon)

  Using suite of portable equipment and demonstration experiments
  - SEM
  - STM
  - AFM
  - Fluorescence microscopy
  - MEMS
  - Microfluidics
  - etc.

New in 2007

Outreach to Under-represented Community



New in 2007

NNIN Diversity Activities
Research Experience for Underrepresented Faculty

- NNIN funds to support underrepresented faculty research efforts at NNIN facilities
  - In residence at NNIN site
  - Working on 10 week project in conjunction with NNIN staff and NNIN associated faculty
- Total of 5 positions across NNIN
- First competition deadline: Oct. 1, 2007

- Goals:
  - Encourage faculty with interest in nanotechnology
  - Increase faculty awareness of possibilities for incorporation of nanotechnology concepts in curriculum
  - Increase faculty awareness of NNIN capabilities for support of small nanotechnology research programs
  - Via faculty, increase student awareness to nanotechnology careers and undergraduate nanotechnology research opportunities (e.g. REU)

New in 2007

Our Reach

- K-12 Community
  - K-12 students
  - K-12 teachers
- Undergraduates
  - REU program
  - Capstone semesters - community college students
  - Laboratory support/training for undergraduates
- Graduate Students, post-docs, faculty, and other professionals
  - Workshops
  - Meetings and Seminars
- General Public
  - Web sites
  - Outreach, brochures, etc.
  - Community programs

Lego activity at the University of Michigan

ASME Nano Boot Camp at the University of Minnesota

NNIN programs reached > 10,000 individuals in 2006