Acknowledgements

NSF:
CCLI, IGERT, ADVANCE, EPSCOR

DOE & NSRC:
Center for Integrated Nanotechnologies (CINT)
New Mexico Nanoscience Education Network

Bridging Biology and Physics Undergraduate Education through Nanoscience: A New Mexico Network Approach

CCLI Phase 1 Award Number: 0633736

Boris Kiefer, Physics, NMSU Main
Vicente Lombrana, Biology, NMSU Alamogordo
Elba Serrano, Biology, NMSU Main
Jacob Urquidi, Physics, NMSU Main
(Nanoscience) Research and Education: Economic Impact & Legislation
Nanotechnology Market Forecast to 2013

- “global market for nanotechnologies is projected to grow at a CAGR of around 20% till 2013”
- “nanotechnology products expected to impact nearly all-industrial sectors and will enter the consumer markets in large quantities.”
- “market for nanotechnology incorporated in manufactured goods will be worth US$ 1.6 Trillion, -a CAGR of more than 49% in 2009-2013.”
- “growth will largely be driven by massive investment in nanotechnology R&D by both governments and corporates across the world.”

Legislation

- (2001) Clinton administration raised nanoscale science and technology to a federal initiative, the National Nanotechnology Initiative (NNI).


The table below presents the requested budget breakdowns by agency.

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<th>Table 1 NNI Budget, 2008 - 2010 (dollars in millions)</th>
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<td>**TOTAL *****</td>
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*Based on preliminary allocations of the American Recovery and Reinvestment Act of 2009 (P.L. 111-5) appropriations. These figures may change. Other NNI agencies with ARRA funding, but not listed in the table, are in the process of determining their allocations.

http://www.nano.gov/html/about/funding.html
America Competes Act PL110-69 (Bush 2007)

- America Creating Opportunities To Meaningfully Promote Excellence In Technology, Education, And Science Act (America COMPETES).

- “keep America the most innovative nation in the world by strengthening scientific education and research, improving technological enterprise, attracting the world's best and brightest workers, and providing 21st century job training.”

- Mandates fellowships, equipment, infrastructure, ethics training
America Competes Act 2007 PL110-69

• NSF must ensure provisions for mentoring and training in the responsible and ethical conduct of research for undergraduate and graduate students and postdoctoral researchers included in grants.

• NSF award guidelines now require a plan for “appropriate training and oversight in the responsible and ethical conduct of research” and a description of the mentoring activities for postdoctoral researchers.

“NIH will identify a number of Signature Initiatives that will support exceptionally creative and innovative projects and programs—and potentially transformative approaches to major challenges in biomedical research.

The initiatives will cover new scientific opportunities in nanotechnology, genome-wide association studies, health disparities, arthritis, diabetes, autism, the genetic risk for Alzheimer’s disease, regenerative medicine, oral fluids as biomarkers, and HIV vaccine research.”

http://www.hhs.gov/recovery/reports/plans/scientific_research.pdf
(Nanoscience) Research and Education: NEW MEXICO Students
New Mexico population

1,969,915 New Mexicans

- 44% White Hispanic 874,688
- 42% White non-Hispanic 833,274
- 9.5% American Indian or Alaskan Native, 186,256
- 3.0% Black, 56,083
- 1.4% Asian, 27,722
- 0.1% Native Hawaiian or Pacific Islander, 2,787

Most commonly claimed ancestry groups:

- Mexican (16.3%)
- American Indian (10.3%)
- German (9.8%)
- Hispanic (9.4%)
- Spanish (9.3%).

07/07 US Census Estimate
What are the educational prospects for young New Mexicans?

- Once in the postsecondary system, only 38\% of first-time, full-time students complete a bachelor’s degree within six years of entering college (vs 53\% in top states)
- 35\% young NM adults attend college by the time they are 19 (vs 53\% in top states)
- 49\% of New Mexico high school graduates require remediation in one or more subjects.
Less than 50% of NM students who enter elementary school complete a HS degree.
Disparities in Academic Achievement in NM

NM Students: Pathway from HS to BA/BS (1999-2000)

http://www.higheredinfo.org/analyses/
Disparities in Academic Achievement in NM

NM Students: % of Demographic Group

- NM 18 Year-Olds
- NM HS Graduates
- NM Bachelor's Awarded
Disparities in Academic Achievement in NM

Demographic Representation  HS to BS

http://www.higheredinfo.org/analyses/
“Educational Equity and Access

The mission of the Office of Educational Equity and Access (EE&A) is to address questions of equity, access and participation of underrepresented populations in higher education in New Mexico.

Our goals are to foster dialogue and initiate policy to address pertinent issues related to educational equity and access. “
P20

State’s response

“What is P20?

- P20 refers to a seamless system of education that follows student progress from Pre-K though postgraduate study and into the workforce.
- It is a coordinated set of policies designed to ease student transitions between grades and schools by providing student information, support services, and coordinated policies among all sectors of the educational system.

Why is it Necessary to Address Education from a P20 Perspective?

- The current lack of alignment between P12 and postsecondary is reflected in the high remediation rates at New Mexico colleges and universities. “
Can students in New Mexicans reap the benefits of economic opportunity offered by nanoscience and nanotechnology?
Approach:  
A statewide network of 2 yr and 4 yr faculty

- Collectively address the needs of our students – enable success in STEM careers
- Establish partnerships with interdisciplinary and innovative thinkers – potential for national impact beyond NM in Phase 3 project
- Align with state (P-20) and federal goals (NNI, America Competes, ARRA stimulus)
- Train future faculty by including students in the dialogue
- Forge research collaborations
New Mexico Nanoscience Education Network

Bridging Biology and Physics Undergraduate Education through Nanoscience: A New Mexico Network Approach

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The Course, Curriculum, and Laboratory Improvement (CCLI) program seeks to improve the quality of science, technology, engineering, and mathematics (STEM) education for all undergraduate students.

CCLI supports three types of projects representing three different phases of development, ranging from small, exploratory investigations to large, comprehensive projects.
CCLI Project Review Criteria

1. Quality, Relevance, and Impact
2. Student Focus
3. Use of and Contribution to Knowledge about STEM Education
4. STEM Education Community-Building
5. Expected Measurable Outcomes
6. Project Evaluation
CCLI NMNEN Project Goals

- Develop **nanoscience proficiency** among faculty in New Mexico postsecondary institutions

- Build an educational **network that crosses institutional and disciplinary boundaries** by uniting 2-yr and 4-yr faculty in a common educational endeavor.
NMNEN Project Goals

- Disseminate and produce interdisciplinary teaching materials that will incorporate nanoscience into undergraduate biology and physics education. [NanoEd Resource Portal http://www.nanoed.org/aboutNanoEd]

- Incorporate assessment of student learning and evaluation of the project on an ongoing basis
NMNEN Goals

- Increase participation of women and underrepresented minority faculty and students in nanoscience research and education – essential for broad impact and to achieve better parity with state demographics
This project involves development of a state-level educational network that unites faculty at research universities and faculty at community colleges in a shared teaching enterprise around the common theme of the integration of nanoscience into biology and physics classes. The project participants include faculty from a diverse set of 4 year institutions and community colleges in New Mexico, as well as researchers from national laboratories.

This project is funded by a CCLI Phase I award (#0833736) from NSF DUE.

---08/07/2009---

**Nano(bio)science Workshop Scheduled for September 2009**

The [2nd NMNEI Workshop](http://biology-web.nmsu.edu/serrano/nmnen/index.html) for faculty and researchers who are interested in promoting nanoscience education in New Mexico will be held on Sunday 09/27 and Monday 09/28 at the Santa Fe Hilton. The workshop is co-sponsored by NSF DUE CCLI 0833736 and the New Mexico Consortium.

Faculty, researchers, and students interested in attending the NMNEI workshop are invited to submit an [APPLICATION](http://biology-web.nmsu.edu/serrano/nmnen/index.html).

The workshop is limited to 40 attendees and will be held as a satellite meeting to precede the CINT User Conference. Travel awards are available for participants who need assistance in order to attend both the workshop and the CINT User Conference.

**Participating Institutions:**

- New Mexico State University, Las Cruces, NM
- New Mexico State University - Alamogordo, Alamogordo, NM
- New Mexico State University - Dona Ana, Las Cruces, NM
- Diné College, Shiprock, NM
- New Mexico Institute of Mining and Technology
- Northern New Mexico College
- University of New Mexico, Albuquerque, NM
- University of New Mexico, Gallup, NM
2008: Undergraduate Courses (E. Serrano, NMSU)

Introduction to Nanobioscience
Instructor: Dr. Elba Serrano
Biology 350 Section M04 CRN #22242
1 credit mini session 01/22/08-03/18/08
Class meets Tuesdays 2:30-3:55 pm

This class is designed for undergraduate students who are curious about nanoscience and who wish to learn about its applications for biological research, especially in biotechnology and medicine. The class will combine lectures with student in-class activities and will include presentations by guest speakers from MIT and national laboratories. Class discussion will focus on understanding the significance of biosensors, molecular machines, and nanostructured materials for nanoscience research. Students will receive guidance on how to apply for summer internships in nanoscience research.

Non biology majors are welcome. One year of introductory chemistry, physics, or biology is recommended.

Art of Scientific Discovery
(freshmen Honors 115)

Nanobioscience
(Bio 350 soph, juniors)

Topics: Introduction to Nanoscience, Basic Nanotechnology, Making and Measuring Nanostructures, National Nanotechnology Initiatives, Nanoscience Internships, Ethical and Societal Dimensions of Nanoscience Research, The Origins and Basic Physics of Nanoscience, Nanocrystal Quantum Dots, Semiconductors, Photovoltaics, Molecular Motors, BioSensors, Heavy Metals

http://biology-web.nmsu.edu/serrano/neurolab/teachingadvising/courses.html
NMNEN Workshop 1 (2007)

Participation

- NMSU (Las Cruces, Alamogordo, Dona Ana)
- Dine College
- New Mexico Institute of Technology
- University of New Mexico (Albuquerque, Gallup)
- CINT, LANL
- Kennesaw State University
- Commission on Professionals Science and Technology
- Jackson Laboratories
Workshop 1: Summer 2007 (2.5 days)

- Preparing Students for the US Scientific Workforce
- Measurement at the Nanoscale: Exploring the Invisible
- Nanoscience and Energy Technology
- Nanostructures and Biological Systems
- Enhancing Science Education through Collaborative Networks
- Networking Goals and Strategy (statewide integration)
- Nanoscience Curricular Goals and Collaborative Strategy
- Outcomes Assessment of Student Learning, Peggy Maki
NMNEN 2nd Workshop: 2009

Align with CINT User Conference

- Hilton Santa Fe, September 27-28
- co-sponsored by IAS and NSF DUE CCLI 0633736
- Sunday 09/27pm
- Reception 5:00-6:30
- Dinner: 6:30-9:00
- Monday all day 8:00-5:30
- Tuesday/Wednesday 09/29 and 09/30 CINT User Annual Conference
Workshop 2: Fall 2009 (1.25 days)

- CCLI phase 3: What it takes and how to get there.”
- Challenges for nano(bio)science curriculum development”
- “Nanoscience Education Initiatives in New Mexico”
- “Student perspectives on nano(bio)science course design”.
- Working lunch/poster session:“Partnerships for nanoscience education in NM”
- “Dissemination of teaching modules and learning materials”
- Nanoscience research opportunities for faculty and students at LANL, Sandia, and CINT”
- Tuesday/Wednesday 09/29 and 09/30CINT annual user meeting
Application for the 2009 NMNEN Workshop

Applications are invited from faculty at universities and community colleges, researchers and students who are interested in attending the 2nd NMNEN Nano(bio)science Education Workshop in Santa Fe NM on September 27-28, 2009. The workshop directly precedes the 2009 CINT Users Conference in Santa Fe, NM. Travel awards are available for participants who need assistance with the costs of attending both the NMNEN workshop and CINT meeting. Review of applications will begin on August 24.

ABSTRACT: This professional development workshop is designed for faculty and researchers who are interested in forming collaborations with interdisciplinary thinkers and who aspire to enhance the preparedness of New Mexico students to participate in STEM research. The workshop is intended to inform educators at 2-year and 4-year colleges and universities about cutting edge research in nano(bio)science. In turn, researchers will learn about educational opportunities and modes of student engagement in research and creative activities. Workshop activities will provide a forum for discussion of educational needs, strategies, materials, and concepts that are necessary to incorporate nano(bio)science themes in STEM college education. Undergraduate and graduate students are encouraged to submit applications for participation on a panel that will provide student perspectives on nano(bio)science curriculum needs and course design. The workshop is limited to 40 participants and is co-sponsored by the the National Science Foundation (DUE CCLI 0633756) and the New Mexico Consortium.

TO APPLY:
(1) complete the ONLINE FORM
(2) upload your resume/CV (2 pages maximum preferred, NSF biosketch recommended) as a pdf file to the NM Consortium Satellite Event website. Be sure to include yournameCV as part of the pdf filename.

DESCRIPTION OF THE ACTIVITY: The current century most likely holds challenges that will have profound effects on people's way of living. For example, the dwindling fresh water resources, hygienic health, and increased pollution are expected to pose severe challenges which will affect cities, the urbanization and/or reclamation of rural areas, and the environment and many other aspects of life. Science and technology will play an integral part in mastering these regional, national, and global challenges. Nano(bio)science is a particularly promising research area in this effort since it provides a link between life and material sciences that is expected to be essential in the development of ethical and socially acceptable solutions. The NMNEN workshop will bring researchers and educators from 2-year and 4-year colleges and universities together to initiate new, and enhance existing, educational partnerships with the goal of developing teaching strategies and providing the expertise necessary for faculty to incorporate nano(bio)science themes into undergraduate education across the state of New Mexico. To facilitate this effort, the workshop will provide opportunities for participants to discuss existing nano(bio)science initiatives in New Mexico, formulate common goals and needs for the growth and development of the network, as well as modes of active student engagement and knowledge transfer between educators and students. The environment in New Mexico with its national laboratories provides a unique opportunity in the effort to integrate cutting edge nano(bio)science research themes into education. Representatives from LANL, CINT, and Sandia will provide an overview of research opportunities at these New Mexico laboratories. Participants will have an opportunity to present their education challenges and activities at a poster session.
Opportunities offered by a network approach

○ Collectively address the needs of our students – enable success in STEM careers
○ Establish partnerships with interdisciplinary and innovative thinkers – potential for impact beyond NM in Phase 3 project
○ Align with state (P-20) and federal goals (America Competes, ARRAS stimulus)
○ Train future faculty by including students in the dialogue
○ Forge research collaborations
GRAND CHALLENGES
How do we accelerate curriculum reform in response to rapidly emerging interdisciplinary fields?
What questions will we (scientists) ask and how will we use the knowledge gained?
What is our responsibility (as scientists) to the public who funds our research?
Dedicated to our students, the future leaders of the (post-Singularity) world