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# **Nanotechnology Undergraduate Education (NUE) in Engineering Program**

**NSF Grantees Conference on Nanoscale Science and  
Engineering**  
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# NUE Program History

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- **Part of the 25-agency, \$1.3 B/year (FY 06), National Nanotechnology Initiative (NNI)**
- **Initiated in FY 2003 as one of four components in NSF Nanoscale Science and Engineering (NSE) Program including: Nanoscale Interdisciplinary Research Teams (NIRT), Nanoscale Exploratory Research (NER), and Nanoscale Science and Engineering Centers (NSEC)**
- **Cross-directorate program-MPS, ENG, SBE, EHR, CISE, and BIO**
- **MPS Chemistry lead organization-FY 2003 and FY 2004**



# NUE Program History

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- **Funding level: \$100K/12 months-FY 2003 and FY 2004; freshman and sophomore levels only**
- **FY 2005**
  - **ENG takes over management with EHR and SBE as partners**
  - **funding level/duration increased to \$200K/24 months**
- **FY 2006-all levels participate; focus on nanoscale engineering with relevance to devices and systems and/or social, economic and ethical issues surrounding nanotechnology**
- **FY 2007-title changed to NUE in Engineering; eligibility requirements changed**

# NUE Program Statistics

	Props.	Awards	Success Rate	Total NUE \$M*
<b>FY 03</b>	80	33	41%	3.3
<b>FY 04</b>	70	34	48%	3.3
<b>FY 05</b>	87	14	16%	2.7
<b>FY 06</b>	114	11	9%	2.1
<b>FY 07</b>	75	12	16%	2.3
<b>FY 08</b>	67	12	18%	2.3

\*MPS, EHR, SBE, CISE, BIO, EPSCoR



# NUE Contributes to NSF Strategic Goals

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- The NUE in Engineering program is a significant contributor to achieving the NSF goal of fostering research that will advance the frontiers of knowledge, emphasizing areas of greatest opportunity and potential benefit and establishing the nation as a global leader in fundamental and transformational science and engineering.
- In addition, NUE helps to expand the scientific literacy of U.S. citizens particularly in nanoscale science, engineering, and technology.



## NUE Program Objectives

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- Integrate nanoscale science, engineering, and technology into undergraduate engineering curricula;
- Generate practical ways of introducing nanotechnology into undergraduate engineering education with a focus on devices and systems and/or on the social, economic, and ethical issues that surround nanotechnology;



# NUE Program Characteristics

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The NUE Program emphasizes new approaches to undergraduate engineering education through interdisciplinary collaborations that could lead to, but not limited to:

- New examples of undergraduate engineering courses that are presented through development of laboratory and demonstration experiments, manuals and other written materials, software, and web-based resources;



## NUE Program Characteristics

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- Development and dissemination of new teaching modules for nanoscale engineering of relevance to engineering education that can be used in existing undergraduate courses;
- Incorporation of undergraduate research opportunities in nanoscale engineering into the curriculum at any level; and



# NUE Program Characteristics

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- Development of courses or curricular enhancements related to nanoscale engineering and technology and environmental or social change.

# NUE: Teaching Nanosystems Engineering with Active Learning Experiences

Louisiana Tech University, EEC-0407097, Hisham Hegab



- Preparing a diverse, globally engaged STEM workforce
- Impacted students from elementary school to sophomore-level undergraduates
- Helped establish **first B.S. in Nanosystems Engineering degree program in the U.S.**
- 25 undergraduates enrolled, 1<sup>st</sup> program graduates-May 2007

# NUE: Developing Undergraduate Nanoscale Experiences for the Sciences (Project DUNES)

University of Northern Colorado, Greeley, CO  
(0532516) K. Pacheco, A. Morrow-Baker, J. Moore, R. Schwenz, J. Suits



To accomplish their goals concerning nanotechnology education at the University of Northern Colorado, the project team is:

- incorporating a series of **nanoscale science modules** into currently offered laboratory courses and implementing use of a common instrument across these courses
- offering summer **internships** for undergraduate pre-service teachers where they help develop and implement the nanoscale science modules
- providing students the opportunity to participate in **interdisciplinary learning communities** focused on nanoscale science

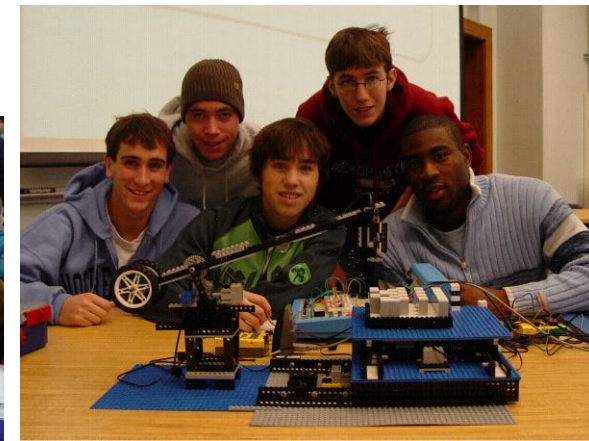
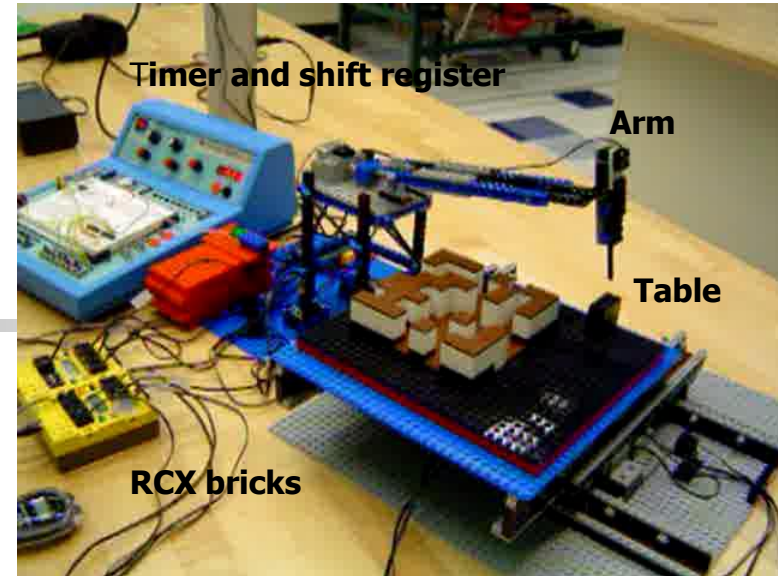
The overall project will impact a large number of students, many of which are from groups underrepresented in STEM disciplines. UNC has 9,934 undergraduate students, of whom 1,332 (13.9%) are minorities. The program will impact courses including STEM degree requirements, General Education requirements, and pre-service teacher education requirements, or about 22% of a UNC STEM student's load, and 5% of a non-STEM student's load.



# NUE: A Freshman-Level Introduction to Nanotechnology Based on Scanning Probe Instruments

PI: Wolfgang Porod, University of Notre Dame (CCR-0304089)

- Developed and implemented new course module
- Module offered to all ND Engineering freshmen
- Students build LEGO model of scanning-probe instrument, after IBM Millipede nanotechnology data-storage concept
- Organized workshop to introduce new module
- Partnered with FIRST LEGO League to create *Nano Quest* challenge, and some 75,000 youths ages 9-14 participated worldwide

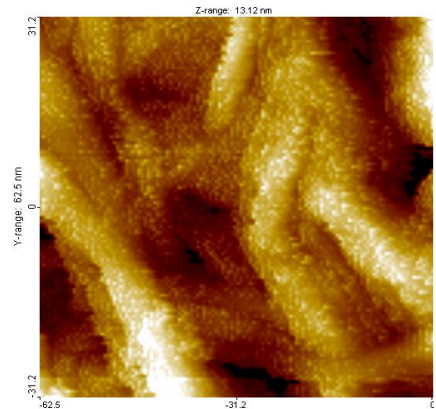


# NUE: Integrating Nanoscale Science Education and Student Research at Jackson State University

T. V. Shahbazyan, W. Walters, F. Hagelberg, *Jackson State University*

**NUE - 0532468**

- The JSU nanotechnology student training laboratory is equipped with:
  - educational atomic force microscope
  - educational scanning tunneling microscope
  - desktop scanning electron microscope
- Current Student Research
  - Study of Carbon Nanotube based paint systems exposed to harsh environmental conditions
  - Environmental durability of Carbon Nanotube based polymers for potential flexible display applications



nano-carbon tubules observed using scanning tunneling microscopy



# NUE in Engineering Program Future

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- FY 2009 competition
- Program solicitation in revision
- Spring 2009 deadline
- \$1.9M/10 awards (est.)
- ENG, EHR, SBE participating Directorates