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Three Rs and an N: Schooling Nano Innovators

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Sandia's National Institute for Nano-Engineering brings together schools, companies and the lab.

By Margaret Lovell

Responding to a clear need to redevelop a culture of technological innovation in American education, Sandia National Laboratories has established the National Institute for Nano-Engineering (NINE) to bring together schools, companies and the Department of Energy's formidable science and technology infrastructure to help create the next generation of innovators.

Regan Stinnett, left, NINE manager at Sandia, with Sarah Bobeck, University of Florida, and Ataur Sarkar, University of California-Davis

In 2005, the report from the National Academies, Rising Above the Gathering Storm, identified concerns about the strength of America's science and engineering education. This wake-up call led Sandia in 2006 to form NINE, a partnership whose initial membership includes Lockheed Martin, Intel, ExxonMobil, IBM, Corning, Goodyear, University of Wisconsin, Rensselaer Polytechnic Institute, University of California at Davis, University of Florida, Yale, Harvard, University of Texas at Austin, University of Illinois, Rice, Notre Dame, University of New Mexico and Harvey Mudd College.

The lab, university and industry partners are responding, too, to the political will behind the America Competes Act of 2007. Signed into law by President Bush in August, the act supports a comprehensive strategy of strengthening the country's scientific education and research. In the White House fact sheet on America Competes, nanotechnology, supercomputing and alternative energy are called out as "promising and critical areas" for increased funding. Of specific interest to Sandia, the act sets a goal for doubling the DOE's Office of Science funding over ten years, increasing from $3.6 billion in FY 2006 to over $5.2 billion in FY 2011.

NINE brings together government lab and industry scientists, students and faculty to do research in leading-edge technical areas. NINE partners provide students—high school through grad school—team research experiences generally unavailable in traditional academic environments. In addition to showing students how science is done in professional settings, NINE also

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exposes students to the non-technical aspects of nano-engineering, including business, legal, political and social issues through courses, seminars and mentoring.
Those social issues, for example, reducing greenhouse gases, are key to attracting today's students. According to Justine Johannes, a Sandia manager and co-director of NINE, "Important social issues can pull the next generation into engineering and the sciences. Their ability to make an impact on those issues can keep them engaged."

In July, Sandia hosted 33 undergraduate and graduate students from 14 universities.. These students worked hands-on with mentors on nano-engineering projects of direct interest to DOE. The technical projects that the students and researchers worked on are all funded by Sandia's Laboratory Directed Research and Development (LDRD) program. This first round of projects are funded at more than $7.5 million. The dozen or so projects in three theme areas—nanoelectronics and quantum information processing, nanotechnologies for energy and nanomaterial synthesis and manufacturing—all have university partners and most have industry partners.

The theme areas are chosen to meet the mission needs of the lab and use its capabilities and facilities as well as providing a compelling challenge to the students. Individual projects within those three themes are selected by a committee of Sandia managers and business developers.

"The NINE program is designed to provide students with access to the best equipment, best technology and best mentorship possible in all aspects of nanoscience and nanoengineering. The projects we work on with them encourage the students, faculty and lab and industry researchers to collaborate on innovative solutions to some of the most challenging and exciting opportunities in science today," says Joe Cecchi, dean of the School of Engineering at the University of New Mexico.

Tim Boyle, a Sandia researcher and NINE project principal investigator, is leading a project on the interaction of nanoparticles with elastomers. He and his team, which consists of lab staff, students from different universities and a number of industrial partners, are trying to understand how nanoparticles interact with elastomers (long-chain polymers that spring back into shape after being stretched like a rubber band) and how to control these interactions. Using both computer modeling and synthetic experiments, the NINE team is attempting to uncover what impact the addition of these nanofillers might have on, for example, rubber for tires. "Systems that include lots of components are very difficult to study as a whole," Boyle says. "We have to separate out the parts and model them with molecular computation and experimentation. Think of it as trying to figure out what makes a cake taste good. You know you like the cake, but you can't really identify why. But if you look at the components—flour, sugar, eggs, butter—you can figure out that the cake is sweet because of the sugar and rich because of the eggs and butter. With our project we are figuring out for tires the equivalent of what would happen if you added a miniscule extra amount of sugar to your cake."

On the less technical side, the students attended seminars providing a broader perspective on innovation and what it takes to mature early stage technologies so that they can provide solutions to real world problems. Seminar topics included technology management, communications, startup case studies and accounting concepts for entrepreneurs.

Leigh Anna Ottley has been working at Sandia as a student intern since she was a high school senior. Now, six years later, she is in her first year of graduate studies in chemistry at the University of New Mexico. She works as a technologist in Tim Boyle's section at the Advanced Materials Laboratory in Albuquerque. She is in the year-round NINE program and participated in last summer's intensive introduction to nanotechnology. "The summer program seems designed to open up our eyes to nanotechnology. We had presentations on different technologies, business rules, communications. I think maybe the best part for the younger students was seeing the diverse research areas at Sandia—chemistry, physics, biology—were being applied to nanotechnology."

Regan Stinnett, Sandia's NINE manager, likens this nanotechnology era to the moon program in the 1960s. "Nanotechnology, like the early space program, brings excitement to students. And like the early moon shots, the multidisciplinary aspects of nano call on a variety of academic disciplines, including electrical engineering, physics, chemistry, material science. The challenge for universities will be how to provide the breadth of learning that the new technology needs without sacrificing the depth of the academic disciplines. It's possible that NINE can provide some of that scientific breadth, as well as the societal aspects, and help create innovative leaders who understand all the different disciplines, all the varying points of view."

Margaret Lovell reports on Sandia National Laboratories for Innovation.

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