U.S. HOUSE OF REPRESENTATIVES
COMMITTEE ON SCIENCE AND TECHNOLOGY
SUBCOMMITTEE ON RESEARCH AND SCIENCE EDUCATION

HEARING CHARTER

Nanotechnology Education

Tuesday, October 2, 2007
2:00 a.m. - 4:00 p.m.
2318 Rayburn House Office Building

1. Purpose

The purpose of this hearing is for the Subcommittee to receive testimony on H.R. 2436, the Nanotechnology in Schools Act, and also to review current nanotechnology education activities supported under the National Nanotechnology Initiative and to explore issues associated with educating students and the public about nanotechnology.

2. Witnesses

- **Mr. David Ucko**, National Science Foundation, Deputy Division Director of the Education and Human Resources Division on Research and Learning. Mr. Ucko coordinates education activities in nanoscale science and engineering across NSF.
- **Dr. Navida Ganguly**, Head of the Science Department at Oak Ridge High School, Oak Ridge Tennessee.
- **Dr. Hamish Fraser,** Ohio Regents Eminent Scholar and Professor, Department of Materials Science Engineering, the Ohio State University.
- **Dr. Ray Vandiver,** Vice President of New Project Development, Oregon Museum of Science and Industry.
- **Mr. Sean Murdock,** Executive Director, NanoBusiness Alliance.
- **Dr. Gerald Wheeler,** Executive Director, National Science Teachers Association.

3. Over-Arching Questions

- What unique benefits does access to high-tech equipment generally offer to high school students, undergraduates and community college students, and visitors to informal science centers?
- What science, technology, engineering, and mathematics (STEM) education goals do hands-on opportunities with high-tech equipment fulfill at the secondary school level and at the post-secondary school level? What goals does providing these opportunities meet for the nanotechnology research and business communities?
- What factors need to be considered when bringing high-tech equipment to the classroom?
- What types of educational activities is the Federal Government funding in nanoscale science and engineering under the National Nanotechnology Initiative?

Is the level of resources available for these activities adequate? Are the priorities for funding appropriate?

4. Background

Nanoscale Science and Engineering

The emerging field of nanoscale science and engineering (NSSE)— the science of manipulating matter at the molecular level— holds tremendous potential. Research in this area has already led to medicine-dispensing contact lenses, stain-resistant clothing, and many other advances in science, health, and consumer products. The impact of this technology on Americans' quality of life and economic prosperity could be enormous and thus it is clearly necessary for the United States to stay at the forefront of scientific research and development in the NSSE field. To accomplish this, the Nation needs a full pipeline of talented engineers and scientists, and a scientifically literate public, able to exploit and understand this new science.

H.R. 2436, the Nanotechnology in Schools Act

The purpose of H.R. 2436, the Nanotechnology in Schools Act, is to expose American students to the high-tech realm of nanotechnology, leading them to a greater interest and higher facility in science and technology. The bill would direct the National Science Foundation to create a grant program making it possible for eligible institutions to purchase nanotechnology equipment for educational purposes. The qualifying institutions— high schools, two-year colleges, undergraduate serving programs, and informal science education centers— could apply for competitively awarded, merit-based grants of up to $150,000 used to purchase instrumentation and materials to teach NSSE principles to students and/or the public. In addition to equipment, the funds could be used for relevant software, as well as teacher and faculty professional development, and student educational activities. In making their awards, NSF is encouraged to select institutions that represent a diverse geographic area and a diverse student body. The activities in H.R. 2436 are authorized at $15,000,000 for fiscal year 2008, and for such sums as may be necessary for fiscal years 2009 through 2011.

Current Nanotechnology Education Activities under the National Nanotechnology Initiative

The National Nanotechnology Initiative (NNI) has funded more than $6918.1 million in research and related activities in NSSE across the federal science agencies since it began in 2001. In fiscal year 2007, Congress funded research in this area at $1353.9 million. As part of its work on this initiative, NSF supports a number of educational activities designed to teach K-16 students, science teachers, faculty members, and the general public about nanotechnology. In fiscal year 2006, NSF funded $26.2 million in this area and the agency reports similar funding levels for nano education for this year and next[1]. NSF estimates they educate 10,000 students and teachers per year with these funds. Major NSSE education initiatives include the National Center for Learning and Teaching (NCLT) in Nanoscale Science and Engineering and the Nanoscale Informal Science

[1] FY2007 estimate: $27.8 million; FY2008 budget: $28.6 million.

Education (NISE) Network. NCLT is a consortium of five universities with a mission to foster the Nation's talent in NSSE by developing methods for learning and teaching through inquiry and design of nanoscale materials and applications. They perform research and serve as a clearinghouse for information regarding NSSE curriculum, teaching methodologies, and professional development for the undergraduate and K-12 levels. NCLT is operating in the fourth year of a five year $15,000,000 million grant. The NISE network received a $12.4 million dollar grant from NSF in 2005 to develop methods of introducing the nanotechnology to the public and to draw students to careers in NSSE.

NSF also has a Nanotechnology Undergraduate Education Program which funded $42.7 million since 2003. The grants in this program have gone to develop curriculum and purchase equipment in NSSE for undergraduate students in different science and engineering disciplines. As part of the Advanced Technology Education Centers program, NSF has funded $2.68 million since 2004 to develop nanotechnology related technician education programs at community colleges.

Important Considerations

The vital role NSSE will play in the future of science and technology dictates the necessity of supporting educational activities that will cultivate students who are enthusiastic and able to pursue careers in all aspects of nanotechnology. However, to maximize the benefit the opportunity to work with high-tech scientific equipment can have for students, the new technology and concepts must be carefully integrated with the larger body of science knowledge students must already learn. Professional development for anyone teaching new technology should also be considered an essential part of brining high-tech scientific equipment to the classroom. NSF's current and future NSSE educational activities offer the chance to create holistic programs that will increase the depth and breadth of student's science knowledge.

5. Questions to Witnesses

Dr. David Ucko

1. Please describe NSF's current activities in nanoscale K-16 science education and the funding level for these activities. Why does NSF believe funding and promoting nanoscale science and engineering educational activities is important? How does nanoscale science and engineering education fit into the larger picture of improving STEM education and literacy in all levels of the population?

2. What educational activities (and which audiences) does NSF believe are most important to reach with information on nanoscale science and engineering?

3. At all levels, but the K-12 and informal science education level especially, is professional development and the integration of this new, advanced field into existing curriculum, receiving adequate attention and forethought?

4. What is NSF's opinion on H.R. 2436, the Nanotechnology in School Act? Would this program compliment the Foundation's current activities in nanoscale science education?

Mr. Sean Murdock

1. What challenges do nanotechnology oriented businesses currently face in filling their workforce needs? Are there particular skills that are in short supply?

2. What effects would the nano-business community hope to see from introducing students and the public to nano-science through hands-on experiences?

3. Are nano-oriented businesses currently engaging in educational activities? How can they be encouraged to form partnerships that will give students opportunities beyond the classroom where they can further explore and engage with nanotechnology?

Dr. Navida Ganguly

1. Please describe your experiences using high-tech scientific equipment in the high school classroom. What benefits do you feel students would receive from having the opportunity to work with nanotechnology equipment? Would students from a wide variety of backgrounds be able to use and learn from the equipment?

2. With the myriad topics high school science teachers must currently cover, how do educators strategically choose new experiences for students in the sciences? How do you integrate the newest concepts into the curricula to give students an appreciation for the new material and an excitement about science, as well as a deeper understanding of the fundamentals?

3. What kinds of professional development opportunities would teachers need to help them integrate nanotechnology into their curriculum and properly use and maintain high-tech equipment?

4. Are there problems obtaining funds needed for the maintenance of high-tech equipment? How does Oak Ridge High School address these?

Dr. Hamish Fraser

1. Please describe current nanotechnology education efforts at the undergraduate level. As new fields emerge in science, how do university science departments merge them into the current undergraduate curriculum?

2. How would a grant program, like the one proposed by H.R. 2436, be used by undergraduate serving programs? At the college level, does the opportunity to work with new technology draw in students who might otherwise have been uninterested in science? Do hands-on experiences offer a unique learning opportunity that is difficult to replicate in a lecture?

3. What types of nanotechnology equipment could be used for educational benefit at the undergraduate level?

Dr. Ray Vandiver

1. Please describe the nanoscale science and engineering educational activities the Oregon Museum of Science and Industry (OMSI) is engaged in and OMSI's role in the Nanoscale Informal Science Education Network.

2. Would H.R. 2436, the Nanotechnology in the Schools Act, be a beneficial resource for informal science education institutions? What priority should it be given relative to other kinds of support for informal science education activities? How would science museums integrate advanced equipment into their educational activities?

3. What types of professional development opportunities are available to informal science educators? What types of programs would need to exist to ensure that these educators understand both the scientific concepts, as well as the equipment?

4. How do informal science education centers decide which subject matter they will focus on? What resources do they use to help create exhibits and programming that matches content to the knowledge level and interest of the audience?

5. Do science museums have resources to maintain advanced equipment?

Dr. Gerald Wheeler

1. What is the National Science Teachers Association's opinion on H.R. 2436, the Nanotechnology in School Act? What is the appropriate role for high-tech equipment in the secondary science classroom?

2. With the myriad topics high school science teachers must currently cover, how do educators strategically choose new experiences for students in the sciences? How do you integrate the newest concepts into the curricula to give students an appreciation for the new material and an excitement about science, as well as a deeper understanding of the fundamentals?

3. What kinds of professional development opportunities would teachers need to help them integrate new, high-tech equipment into their curriculum and properly use and maintain high-tech equipment?