Vision for Global Nanoscale Science and Engineering Education

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Outline

- Global Challenges over the next 30 years
- Challenges facing US STEM education
- What can NSEE do?
- Global Nanotechnology Network
- About this Workshop

Over the Next 30 Years…

- **Oil production will peak**
  - Need “green energy” development
- **Global warming**
  - Need advanced environmental protection systems
- **Increase in population density**
  - Global health protection issues (food, water, disease control, etc.)
- **Nanotechnology will play a significant role in global energy, environment, health, and economic development.**
  - The world will soon need over 2 M nanoworkers

To address these challenges, our citizens must learn to:

1. **Think critically and make sound judgments**
2. **Solve complex, multidisciplinary, open-ended problems**
3. **Create and launch new enterprises**
4. **Communicate and collaborate effectively**
5. **Make innovative use of knowledge, information and opportunities**
6. **Take charge of financial, health and civic responsibilities**

** Source: 21st Century Skills, Education & Competitiveness Report by Partnership for 21st Century Skills (2008)*

➢ **NCLT trains the next generation of nano-literate workers with these 21st Century skills to maintain a US competitive edge in the new nanotech economy.**

STEM Challenges in the US

- STEM education is the building block for the knowledge-intensive global economy of the 21st century
- Continued global achievement gap between U.S. students (even our top performing students) and their international peers
- Less than 40% of US 25-34 year olds are college graduates, compared to nearly 55% in Russia, Canada, Japan, and Korea.

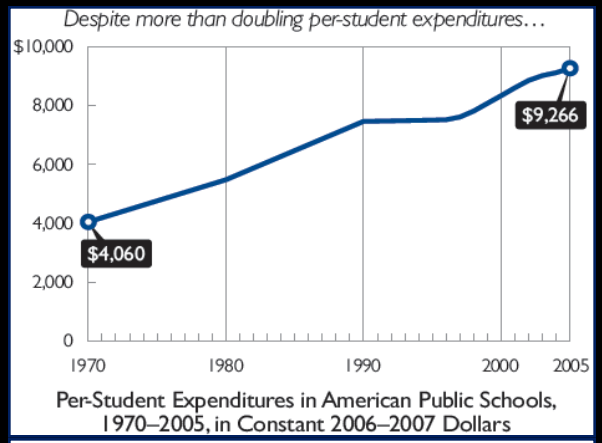
***Source: Science and Engineering Indicators 2006**

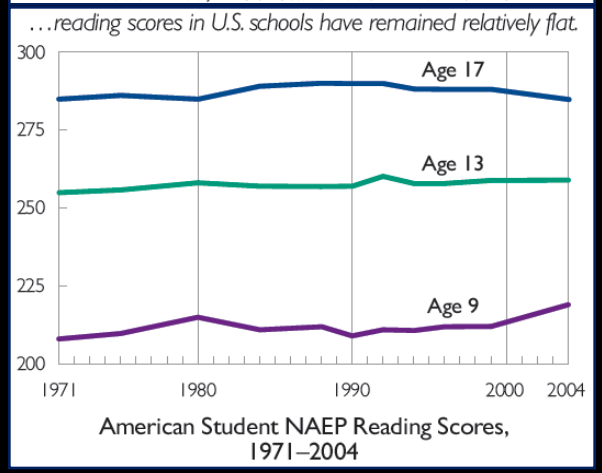
Basic Challenges in STEM Education

- **Educating a science-literate citizenry is critical to continued US success in the global economy**
- **Secondary institutions must adapt to a world altered by technology, changing demographics and globalization**
  - Several national studies confirm the insufficient preparation of high school graduates for *either college-level work or the changing needs of the workforce.*
  - Low proficiency performance level, only 1/3 of 4th and 8th grade students reached the proficiency levels for their grades. Even fewer 12th grade students did.

Funding Challenges in K-12 STEM Education

- **Spending increases have not produced an increase in high school achievement rates**





1. US spending at all-time high – 49% increase over past 20 years
2. Since 1985, real federal spending on K-12 education has increased by 138%
3. Only 17% of seniors are considered proficient in mathematics
4. Only 36% are proficient in reading

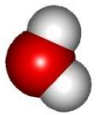
Teacher Challenges in K-12 STEM Education

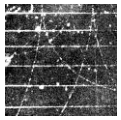
- **A paucity of teachers** who have the necessary knowledge and skills to effectively teach these subjects
- **Inadequate teacher compensation and professional development** to attract, prepare and retain high-quality teachers
- **Lack of interdisciplinarity** - Subjects are taught in a compartmentalized manner and teachers are isolated within discipline-based departments

Student Challenges in K-12 STEM Education

- **Students generally lack motivation** and have low self confidence in learning STEM subjects
- **Persistent achievement gaps** in science and math among many student subgroups
- **Sweeping demographic changes** will exacerbate the gaps
  - Racial and ethnic minorities will comprise the majority of the nation's population by 2042

Meeting at the Nanoscale





Biology

Chemistry

Physics

Engineering

Tools to Image & Manipulate at the Nanoscale

- 1982 Scanning Tunneling Microscope
- 1986 Atomic Force Microscope
- 1991 NSOM

Macro Scale

Microscopic Scale

Nano Scale

100 nm

1nm

Atomic Scale

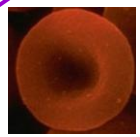
Sub-Atomic Scale

Engineering

Physics

Chemistry

Biology



Tools to Fabricate at the Nanoscale

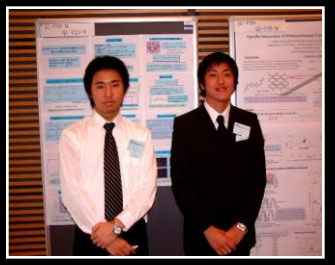
- Lithography (optical, e-beam, print)
- Focused Ion Beam
- Vapor Deposition
- Self-Assembly

NSEE is Unique!

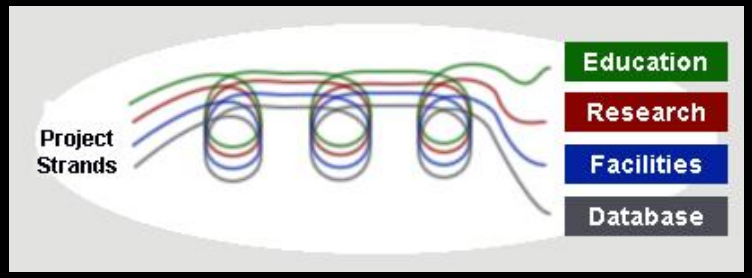
- It is interdisciplinary by nature
- Unique nano-phenomena will intrigue learners and teachers
- Nanoconcepts can enhance STEM learning
- NSEE can equip 21st century workers for global economic development

Global Nanotechnology Network

- Partner Networks in Africa, Americas, Asia, and Europe
- **GNN development workshops** – 2001 (Mexico), 2003 (Japan), 2005 (Germany), 2009 (??)
- Diverse stakeholders in academia, industry, and government



Education is major project strand of the GNN!



NCLT NU · UM · PU · UIC · UIUC · ANL · AAMU · FU · HU · MC · UTEP · PSS

About this Workshop

- **The Goal of this Workshop - Develop a global NSEE community that will greatly enhance NSEE learning and teaching.**
- **Vision - use this community to work together to train the next generation of nanotechnology workers and global leaders to solve the challenges facing our world.**

About this Workshop

This workshop brings together nano researchers and educators from 14 countries to share experience and best practices in NSEE via:

- Plenary and Keynote Lectures
- Panel Discussions
- Poster Sessions
- Group Breakout Sessions
- Group Reporting