Distribution Network Development (DND)

Robert J. Gordon
Senior Executive
What is STEM Education?

STEM =

Science
Technology
Engineering
Mathematics

Cultivate widespread literacy in STEM education!
The demand for STEM education and skills is global.

Students around the world will have to meet common expectations.

Yet, different countries and states face different challenges.

GOAL Balance LOCAL and GLOBAL Pressures.
CTEq was started by five Chief Operating Officers from some of the largest companies in the U.S. along with the Carnegie Corporation of NY.

This is a non-profit, non-partisan CEO-led initiative to help solve America’s innovation problem.

CTEq is meant to answer the call of President Obama’s Educate to “Innovate Campaign” to move the U.S. to the top of the Pack in Science and Math education over the next decade.

CTEq will improve participation and performance of America’s students in STEM education and,

Mobilize the business community to improve the quality of STEM learning in the U.S.
Role of CTEq

- **Advocacy** – build value to improve STEM policy objective.

- Provide research and guidance to member companies to improve investments in STEM education, how to use resources to make most impact.

- Developing rubric tool for analyzing, assessing STEM programs.

- **STEM Design Principles**: What makes a STEM program successful?

- Guide for best practices to strengthen employee engagement (Employee Engagement Committee).
CTEq Goals

- **Great Teaching**
  Improve STEM teaching at all grade levels, with a larger and more diverse cadre of highly capable and inspirational STEM teachers.

- **Inspired Learners**
  Inspire student appreciation and excitement for STEM programs and careers to increase success and achievement in school and opportunities for a collegiate education, especially among females and students of color.

- **A Committed Nation**
  Achieve a sustained commitment to improving STEM education from business leaders, government officials, STEM educators and other stakeholders through innovation, communication, collaboration and data-based decision making.
July 2010  The origin of the relationship between Hitachi and CTEq
During a meeting between Presidential aide John Holdren and Hitachi Ltd. Chairman Kawamura, STEM education in the U.S. and Japan was discussed, and both acknowledged the importance of STEM education.

April 2011  Hitachi becomes a member of CTEq
One of two Japanese companies to become a member (Sony Pictures)
<table>
<thead>
<tr>
<th></th>
<th></th>
<th></th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>2. Accenture*</td>
<td>32. Deloitte</td>
<td>61. Medtricity</td>
</tr>
<tr>
<td></td>
<td>4. The Aerospace Corporation</td>
<td>34. Discovery Communications</td>
<td>63. Microsoft</td>
</tr>
<tr>
<td></td>
<td>5. Agilent Technologies</td>
<td>35. Dow Chemical</td>
<td>64. MITRE</td>
</tr>
<tr>
<td></td>
<td>10. Archer Daniels Midland</td>
<td>40. EMC2</td>
<td>69. Oracle</td>
</tr>
<tr>
<td></td>
<td>11. AT &amp; T</td>
<td>41. Epic Games</td>
<td>70. PASCO Scientific</td>
</tr>
<tr>
<td></td>
<td>12. Aurora Flight Sciences</td>
<td>42. Ernst &amp; Young</td>
<td>71. Prescription Solutions</td>
</tr>
<tr>
<td></td>
<td>13. Autodesk</td>
<td>43. ExxonMobil *</td>
<td>72. PricewaterhouseCoopers</td>
</tr>
<tr>
<td></td>
<td>14. BAE Systems</td>
<td>44. Facebook</td>
<td>73. Procter &amp; Gamble</td>
</tr>
<tr>
<td></td>
<td>15. Ball Aerospace &amp; Technologies</td>
<td>45. Fluor</td>
<td>74. Prometheus</td>
</tr>
<tr>
<td></td>
<td>16. Battelle</td>
<td>46. GE</td>
<td>75. Qualcomm</td>
</tr>
<tr>
<td></td>
<td>17. Baxter International</td>
<td>47. GlaxoSmithKline</td>
<td>76. RAND</td>
</tr>
<tr>
<td></td>
<td>20. Boeing</td>
<td>50. HP</td>
<td>79. SAS</td>
</tr>
<tr>
<td></td>
<td>22. Carolina Biological</td>
<td>52. IBM</td>
<td>81. Samba Energy</td>
</tr>
<tr>
<td></td>
<td>23. Caterpillar</td>
<td>53. Intel *</td>
<td>82. Samsung</td>
</tr>
<tr>
<td></td>
<td>24. Causecast</td>
<td>54. JP Morgan Chase</td>
<td>83. Schlumberger Limited</td>
</tr>
<tr>
<td></td>
<td>27. Cisco</td>
<td>57. LMI Aerospace</td>
<td>86. SMART Tech</td>
</tr>
<tr>
<td></td>
<td>28. Cognizant</td>
<td>58. Lockheed Martin</td>
<td>87. Sony Pictures</td>
</tr>
<tr>
<td></td>
<td>30. Corning</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>31. Dell</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>32. Deloitte</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>33. Dreamworks</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>34. Discovery Communications</td>
<td>35. Dow Chemical</td>
<td></td>
</tr>
<tr>
<td></td>
<td>35. Dow Chemical</td>
<td>36. DuPont</td>
<td></td>
</tr>
<tr>
<td></td>
<td>36. DuPont</td>
<td>37. Eaton</td>
<td></td>
</tr>
<tr>
<td></td>
<td>37. Eaton</td>
<td>38. E-line Media</td>
<td></td>
</tr>
<tr>
<td></td>
<td>38. E-line Media</td>
<td>39. Eli Lilly and Company</td>
<td></td>
</tr>
<tr>
<td></td>
<td>39. Eli Lilly and Company</td>
<td>40. EMC2</td>
<td></td>
</tr>
<tr>
<td></td>
<td>40. EMC2</td>
<td>41. Epic Games</td>
<td></td>
</tr>
<tr>
<td></td>
<td>41. Epic Games</td>
<td>42. Ernst &amp; Young</td>
<td></td>
</tr>
<tr>
<td></td>
<td>42. Ernst &amp; Young</td>
<td>43. ExxonMobil *</td>
<td></td>
</tr>
<tr>
<td></td>
<td>43. ExxonMobil *</td>
<td>44. Facebook</td>
<td></td>
</tr>
<tr>
<td></td>
<td>44. Facebook</td>
<td>45. Fluor</td>
<td></td>
</tr>
<tr>
<td></td>
<td>45. Fluor</td>
<td>46. GE</td>
<td></td>
</tr>
<tr>
<td></td>
<td>46. GE</td>
<td>47. GlaxoSmithKline</td>
<td></td>
</tr>
<tr>
<td></td>
<td>47. GlaxoSmithKline</td>
<td>48. Google</td>
<td></td>
</tr>
<tr>
<td></td>
<td>48. Google</td>
<td>49. Hitachi, Ltd</td>
<td></td>
</tr>
<tr>
<td></td>
<td>49. Hitachi, Ltd</td>
<td>50. HP</td>
<td></td>
</tr>
<tr>
<td></td>
<td>50. HP</td>
<td>51. Honeywell</td>
<td></td>
</tr>
<tr>
<td></td>
<td>51. Honeywell</td>
<td>52. IBM</td>
<td></td>
</tr>
<tr>
<td></td>
<td>52. IBM</td>
<td>53. Intel *</td>
<td></td>
</tr>
<tr>
<td></td>
<td>53. Intel *</td>
<td>54. JP Morgan Chase</td>
<td></td>
</tr>
<tr>
<td></td>
<td>54. JP Morgan Chase</td>
<td>55. Knowledge Universe</td>
<td></td>
</tr>
<tr>
<td></td>
<td>55. Knowledge Universe</td>
<td>56. Eastman Kodak *</td>
<td></td>
</tr>
<tr>
<td></td>
<td>56. Eastman Kodak *</td>
<td>57. LMI Aerospace</td>
<td></td>
</tr>
<tr>
<td></td>
<td>57. LMI Aerospace</td>
<td>58. Lockheed Martin</td>
<td></td>
</tr>
<tr>
<td></td>
<td>59. McKinsey &amp; Company</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

* Founding/Board Member

© Hitachi High Technologies America, Inc. 2012 All rights reserved.
Why STEM Education

Facts & Figures

- **69%**: Share of U.S. students who graduated from high school with a regular diploma in four years (2006)
- **47%**: The share of black males who graduated from high school with a regular diploma in four years (2008)
- **43%**: Share of 2010 U.S. high school graduates who are ready for college-level math
- **29%**: Share of 2010 U.S. high school students who are ready for college-level science
- **25th out of 30**: The U.S. ranking in an international assessment of high schoolers’ performance in math
- **3 million**: The projected shortage of workers with U.S. college degrees, associates or better, by 2018

© Hitachi High Technologies America, Inc. 2012 All rights reserved.
Obama Administration’s STEM Initiative

November 2009, President Obama launches “Educate to Innovate” campaign for excellence in Science, Technology, Engineering & Math (STEM) education.

- Nationwide effort to raise American students from the middle to the top of the pack in science and math
- Five public-private partnerships to reach more than 10 million students over the next four years
- $4.35 billion Race to the Top fund
- Annual science fair at the White House
- Commitment by industry leaders to recruit corporate members to increase the scale, scope and impact of private-sector and philanthropic support for STEM

January 2011, President Obama declares the need for “Winning the Race to Educate Our Children” in his State of the Union Address.

- Proposes in 2012 Budget for $100 million to prepare 100,000 STEM teachers over the next decade
- Investments in K-12 and Undergraduate STEM education
- Funding for 2,000 new Graduate Research Fellowships in 2012
- Private-sector launch of Change the Equation, “a historic effort to scale up effective models for improving STEM education.”
"Our success as a nation depends on strengthening America’s role as the world’s engine of discovery and innovation. I applaud Change the Equation for lending their resources, expertise, and their enthusiasm to the task of strengthening America’s leadership in the 21st century by improving education in science, technology, engineering and math."

President Obama, Sept. 16, 2010
Why Nano Education?

- The NSF estimates that by the year 2015 there will be a need for **2 million workers** worldwide in the fields of nanoscience and nanotechnology.
  - An additional **5 million workers** will be needed in support areas for these fields
    - 0.8-0.9 million – US
    - 0.5-0.6 million – Japan
    - 0.3-0.4 million - EU
- By 2015, nanotechnology is expected to be a **$2.0 trillion “industry”**
In 2010, U.S. unemployment in STEM was much lower than total unemployment.
The Workforce of the Future

Source: Georgetown Center on Education & the Workforce, via GOOD Magazine, 2010
Growth in STEM Careers

- 182,000 science and engineering workers in 1950; 5.5 million in 2007
- Annual growth rate of 6.2%, nearly 4 times the 1.6% growth rate for the total workforce
- Impending retirement of older workers may create even greater demand
Growth Will Accelerate

STEM Skills Pay Off at Every Level

- **STEM** vs **Non-STEM**
  - **Percent earning more than average for own education level**
    - **Less than HS**
      - STEM: 75.4%
      - Non-STEM: 39.2%
    - **HS/GED**
      - STEM: 75.2%
      - Non-STEM: 39.9%
    - **Some College/No Degree**
      - STEM: 71.3%
      - Non-STEM: 37.8%
    - **Associate's**
      - STEM: 66.2%
      - Non-STEM: 40.4%
    - **Bachelor's**
      - STEM: 56.1%
      - Non-STEM: 33.6%
    - **Master's**
      - STEM: 51.9%
      - Non-STEM: 31.9%
    - **Professional**
      - STEM: 16.4%
      - Non-STEM: 33.9%
    - **Doctoral**
      - STEM: 39.4%
      - Non-STEM: 32.6%

*across all occupations

© Hitachi High Technologies America, Inc. 2012 All rights reserved.
Power of Innovation

Innovation is positively correlated to job growth:

- **First-to-market advantage**
  - Growth in exports leads to twice as many jobs as domestic sales

- **Expansionary effect**
  - Factory worker, advertiser, truck driver, salesperson and maintenance person all benefit from new inventions

- **Higher productivity**
  - Increased wages and lower prices
Half of U.S. Patents Awarded in Other Countries

- US: 50%
- Japan: 14%
- S. Korea: 21%
- Germany: 6%
- Taiwan: 4%
- Other: 5%
17 developed nations scored significantly ahead of us in 2009. Only 4 nations scored significantly lower.
12 nations scored significantly ahead of us, and 9 scored significantly lower
Companies Play a Critical Role

- They are at the nexus of global demands and local challenges.
- Companies can advocate for strong, consistent standards.
- More than ever, they can expose youth in their communities to exciting & challenging demands of the global economy.
Key Focus of CTEq

1) Scalability
2) Sustainability
3) Emphasis on long term impact
4) Support of teachers in the STEM field
5) Encouragement of hands-on-learning
6) Address the needs of underrepresented groups: females, urban poor, “underrepresented people of color”
Organizing program that contribute to the STEM education field:

A. **Snapshots**
   - STEM Programs (organized programs, volunteer engagement, sponsorship)

B. **Featured Programs**
   - Independent evaluation of their effectiveness to improve STEM teaching and/or learning
   - Scalability
Hitachi Celebrates Science
Southern CA CAC – Boys and Girls Club – California Science Center

Hitachi High-Technologies America (HTA)
TM3000 Tabletop Electron Microscope

Universal Design
HTA Microscopy

Desktop models available for loan to schools, universities, community colleges, tech institutes, science camps, etc.

HTA trains teachers on how to handle the machine, input samples and adjust magnification.

Hitachi TM-3000
A Portable Scanning Electron Microscope
Why We Need Scanning Electron Microscopes?

- Medicine
- Food Industry
- Materials Research
- Biology
- Geology
- Semiconductor Research
- Archaeology
- Aerospace Research
- Automotive Research
- Cosmetics
- Industrial
- Forensics
- Entomology
- Oceanography
HTA Microscopy
Band-Aid
Cheerio
Eye shadow
• LCD projector used to train entire class

• All students signed up for two 1/2hr SEM sessions

• Acquired 50x, 500x and 5000x of samples they chose
7 Steps of Science Inquiry

1) Choose a topic
   general subject of inquiry

2) Develop a question
   “If I make a change in X, what will happen to Y?”

3) Plan an investigation
   think carefully about the sort of equipment and materials needed to investigate the research question

4) Predict an outcome
   this is not a hypotheses

5) Experiment and observe
   WRITE THINGS DOWN in lab notebook

6) Interpret results
   tabulating, averaging, graphing

7) Communicate findings
   poster, oral presentation

© Hitachi High Technologies America, Inc. 2012 All rights reserved.
Eye of George Washington

Observations

- The bill is actually made from irregular fibers, which are probably organic in nature.
- The lines of ink used to draw the eagle’s head on the back are between 100 and 150 μm wide.
- The ink seems to be made of small crystals only about 1 μm wide. The crystals stick to form stiff structures which can crack, in much the same way paint cracks.

Conclusions

- Because the panning was done mechanically and not by computer, the sample moved the same distance no matter what the magnification. This made it extremely sensitive at 5000x but very slow to search for things at 25x.
- The scale bar made it much easier to determine distances. In an optical microscope, it is usually hard to make accurate measurements.
Microscopy for STEM Educators
Learn the Latest Research, Technology, and Classroom Uses at the SPIE Conference
April 26, 2012 in Baltimore, MD

A one-day session for STEM educators of all levels will be held at the Annual Conference of the International Society of Optics and Photonics (SPIE): Defense, Security, and Sensing. Several interactive lectures and demonstrations designed specifically for teachers will be offered, plus access to the Exhibit Hall with booths and giveaways from over 500 top defense, security, and sensing contractors, suppliers, and integrators. A not-to-be-missed opportunity!

Table-top Scanning Electron Microscope will be available for participant use – bring samples and a flash drive and take home SEM images of your leaf, insect, etc!
The future of our nation hinges on our ability to prepare our next generation to be innovators in science, technology, engineering and math (STEM). Excitement for STEM begins in the earliest stages of our education process. Yet, today far too few of our students are prepared for the challenges ahead. The special session "Microscopy for STEM Educators" is a general interest forum with several notable invited speakers discussing their successful programs implementing microscopy in STEM education to foster student interest and excitement. A hands-on session with tabletop scanning electron microscopes will be held at the end of the presentations and the attendees are encouraged to bring samples of interest and operate the instruments. STEM educators will receive one-day reduced registration fees and will be able to visit the exposition where other microscopes may be on display.

Special Session on Microscopy for STEM Educators

Introduction, Michael Postek, Mary Satterfield and Robert Gordon

Forensic practice in the field of protection of cultural heritage (Invited Paper), Marek Kotrly, Ivana Turkova, Institute of Criminalistics Prague (Czech Republic) [DS300-31]

Science and art at the nanoscale (Invited Paper), Baratunde A. Cola, Georgia Institute of Technology (United States); Kelly Voss, Renee Gaither, Tucker High School (United States); Jamila Cola, Georgia Institute of Technology (United States) [DS300-32]

The National Nanotechnology Infrastructure Network's Education and Outreach Programs: understanding size and scale and the tools of nano (Invited Paper), Nancy Healy, Georgia Institute of Technology (United States) [DS300-33]

10:00 am: Integrating research and advanced microscopy into the high school curriculum, Craig Queenan, Alyssa Calabro, David Becker, Bergen County Technical Schools (United States) [DS300-34]

Coffee Break

Special Hands-on Session on Microscopy for STEM Educators
Thurs. 11:00 am to 12:30 pm

Table-top scanning electron microscopes will be available during this hands-on session and experts will be available to answer questions. The attendees are invited to bring samples of interest and to operate the instruments. Attendees should also bring a memory stick to obtain scanning electron microscope images. Other scanning electron microscopes including laboratory instruments may be found on the exhibition floor. Attendees are encouraged to visit these instruments, as well.
‘Awesome’ high-tech microscope on loan

Walkersville science students get sharper look at life

BY MARGARITA RANCIHEVA
STAR-NEWS

Walkersville High School science students and staff were given a rare chance to work with a 145,000x Scanning electron microscope, which is at least 40 times more powerful than any microscope available to the county schools.

Unlike most microscopes, used in the classroom, which show images in two dimensions and 20,000 to 80,000 times, the electron microscope shows images in three dimensions and has the capability to magnify them up to 50,000 times.

That means that a student can use the microscope to see something in shadow's leg, but also on the tiny hairs that grow from the hairs on the spider’s legs. Walkersville junior Joey Williams

"It is awesome," said the 17-year-old, who has been spending hours with the microscope. "This Monday, I hope to study biology and environmental science at Salisbury University next year. I've used the microscope to examine and take photos of many things, from the structure of mold on old bread crumbs to the structure of a spider web."

This is the best opportunity for me," said Joey, who was excited about the microscope that he came to school by a sunbeam.

Traditional microscopes use visible light to illuminate and magnify objects. An electron microscope uses electrons instead of regular light, which allows them to focus and zoom onto much smaller objects than optical microscopes.

"Scanning microscopes are typically too expensive to be used and maintained at schools," said Walkersville High School science teacher Scott McIntosh, who teaches environmental science and biology.

McIntosh borrowed the microscope from a parent, Larry Cesna, who is also the technical support supervisor for environmental technology at Hitachi High Technologies America, a global company that has a division based in Gaithersburg. Cesna contacted the school and offered to bring in the microscope as part of the National Academy of Science's nationwide educational program, which is sponsored by business leaders in electronics and aimed at encourage more students to explore careers in science.

Walkersville High School junior Abby Burnett and senior Matt Dayton look at a mosquito with an electron microscope during science class on Tuesday.

McIntosh said, "I never dreamed we'd be able to do this."

The electron microscope requires students to place the objects in a vacuum chamber and projects the images on a computer screen, where they can be easily photographed and cataloged.

The best part about that is that students have been able to use the microscope to see in reality and large-scale everything that they have been learning about in the classroom and from their textbooks. McIntosh said, "This is something that has been in the kids' hands all the time. That is the basis of exploration," said McIntosh, who hopes that he will be able to borrow the microscope again in the future.

Abby Burnett, a junior who takes Advanced Placement environmental science class, was also fascinated with the microscope.

"This is nothing like seeing this," she said on Tuesday as she used the microscope to examine the tiny fibers that make up a shred of paper. "It kind of makes life look really cool!"
HITACHI HIGH TECHNOLOGIES AMERICA (HTA)
EDUCATIONAL OUTREACH PROGRAM

Model TM-3000 Table Top Scanning Electron Microscope

ANALYZE
Model TM-3000 Table Top Scanning Electron Microscope used for imaging and analysis of materials and biological specimens.

PORTABLE
Instrumentation is portable; therefore can be moved easily in and out of educational institutions.

SIMPLE
No special environment or electrical conditions – Standard 110V outlet is required.

SUPPORT
HTA certified and trained personnel assist educators with set-up, training and sample analysis.

SET UP
Ideal set-up is for 1-2 week period with first day half hour set-up and 1-2 hour training session. Product is removed within one hour when educator is finished.

RESPONSIBILITY
Educators will be responsible for the instrument that is left at any institution.

Robert J. Gordon | Hitachi High Technologies America, Inc. | phone 905-218-2617 | email robert.gordon@hitachi-hta.com
Winner: Mrs. Cheryl Thomasson - Murray County Schools, Chatsworth, GA
The purpose of this microsite is to create a platform to promote HTA’s participation in U.S. STEM initiatives and HTA’s specific education programs.

Working title for the microsite: “HTA Educates” as it illustrates the overall purpose and mission for the microsite.

This educational program focuses on electron microscopy, specifically HTA’s Table Top SEM Model TM-3000. The three primary facts of the program include:

1) Provide an overview of HTA’s STEM initiative and outreach program
2) Highlight the electron microscopy program and future program
3) Support educators with available teaching tools and resources.

This microsite will be VOID of any commercial activities for our products and will provide a link to our HTA product website.

Targeting June, 2012 release to market!
Hitachi High Technologies America (HTA) will continue our STEM Education Program throughout 2012 with and emphasis on Nanoscience and Nano Materials.

Program will also incorporate other Hitachi Group companies’ support and interaction.

HTA will continue our collaboration and partnership with Change the Equation (CTEq), National Nanotechnology Infrastructure Network (NNIN), and educators throughout the U.S. market.

At HTA, employee-led Community Action Committees (CACs) are charged with assessing the needs and assets in their communities and developing strategies to respond on behalf of their Hitachi Group companies. This program seeks to improve the quality of life in communities where Hitachi employees live and work. “This program” supports two of our key focus areas which are Education and Youth Development.

They are our responsibility. Let’s educate the youth of America and return the U.S. to a leading Innovator globally.