Building Capacity for STEM Education for All

2015 Midwest Regional Noyce Connections Conference
Omaha, Nebraska

Yvonne M. Spicer, Ed.D., DTE, Vice President
Advocacy and Educational Partnerships
National Center for Technological Literacy®
@DrYvie
How do we keep our children inspired, motivated and consistently making progress?
So this is their future!
And finally here...
STEM Milestones in the U.S.

- 2007 NGA STEM Initiative/Innovate to Educate
- 2009 NAEP Science, includes Technological Design
- 2010 Race to the Top, STEM Priority
- 2010 Common Core Standards (46 states)
- 2011-Framework for Next Generation Science Standards
- 2012-13 Next Generation Science Standards (NGSS) includes Engineering Design (26 states)
- 2014 NAEP Technology & Engineering Literacy
- 2015 Revised Science & Technology/Engineering standards
A Leaking STEM Pipeline

2001
4.01 million 9th Graders

2005
2.8 million High School Graduates

Fall 2005
1.9 million College Plans

Fall 2005
Only 1.3 million College Ready

2009–2011
278,000 Majoring in STEM

167,000 STEM Graduates

www.businessandeducation.org
How are we doing as a nation? state? and/or school community?

What Can We Learn Across Geographical Boundaries?
This is a global challenge...
**PISA 2007 Grade 4 Science**

<table>
<thead>
<tr>
<th>Nation</th>
<th>Average Scale Score</th>
</tr>
</thead>
<tbody>
<tr>
<td>Singapore</td>
<td>587 (4.1)</td>
</tr>
<tr>
<td><strong>MASSACHUSETTS</strong></td>
<td><strong>571 (4.3)</strong></td>
</tr>
<tr>
<td>Chinese Taipei</td>
<td>557 (2.0)</td>
</tr>
<tr>
<td>Hong Kong SAR</td>
<td>554 (3.5)</td>
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<tr>
<td>Minnesota</td>
<td>551 (6.1)</td>
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<tr>
<td>Japan</td>
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<td>546 (4.8)</td>
</tr>
<tr>
<td>Latvia</td>
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</tr>
<tr>
<td>England</td>
<td>542 (2.9)</td>
</tr>
<tr>
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<td><strong>539 (2.7)</strong></td>
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<tr>
<td>Hungary</td>
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<td>535 (3.2)</td>
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<tr>
<td>Kazakhstan</td>
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<td>Germany</td>
<td>528 (2.4)</td>
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<tr>
<td>Australia</td>
<td>527 (3.3)</td>
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<td>Slovak Republic</td>
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<tr>
<td>Austria</td>
<td>526 (2.5)</td>
</tr>
<tr>
<td>Sweden</td>
<td>525 (2.9)</td>
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**PISA 2007 Grade 8 Science**

<table>
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<td>Chinese Taipei</td>
<td>561 (3.7)</td>
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<tr>
<td><strong>MASSACHUSETTS</strong></td>
<td><strong>556 (4.6)</strong></td>
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<tr>
<td>Japan</td>
<td>554 (1.9)</td>
</tr>
<tr>
<td>Korea, Rep. of</td>
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</tr>
<tr>
<td>England</td>
<td>542 (4.5)</td>
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<tr>
<td>Minnesota</td>
<td>539 (4.8)</td>
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<tr>
<td>Hungary</td>
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<tr>
<td>Czech Republic</td>
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<td>Russian Federation</td>
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<tr>
<td><strong>UNITED STATES</strong></td>
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<td>Sweden</td>
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<tr>
<td>Scotland</td>
<td>496 (3.4)</td>
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<tr>
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</table>
U.S. Ranked 24th out of 29 OECD Countries in Mathematics

Are the nation’s 12th-graders making progress in Mathematics and Reading?

National average scores from the 2013 National Assessment of Educational Progress (NAEP) did not change from 2009. Among the 11 volunteer pilot states that participated in both the 2009 and 2013 assessments, 4 made gains from 2009 in mathematics and 2 made gains in reading.

IN THE NATION

2013 AVERAGE SCORE IN Mathematics
- increased FROM THE FIRST ASSESSMENT IN 2005
- unchanged FROM THE LAST ASSESSMENT IN 2009

2013 AVERAGE SCORE IN Reading
- decreased FROM THE FIRST ASSESSMENT IN 1992
- unchanged FROM THE LAST ASSESSMENT IN 2009

Percentage of students at or above the Proficient level in 2013
Math, 4th grade

Fourth Grade Mathematics Performance

Figure 8-1
Average fourth grade mathematics performance: 2009

Achievement levels
(Scores range from 0-500)
- Advanced: 282-500
- Proficient: 245-281
- Basic: 214-244

SOURCE: National Center for Education Statistics, National Assessment of Educational Progress.

Science and Engineering Indicators 2012, National Science Foundation.
How are we doing as a nation? Your state?
Science, 4th grade

Fourth Grade Science Performance

Figure 8-3
Average fourth grade science performance: 2009

Map of the United States with states color-coded to indicate average fourth grade science performance. A legend shows the following categories and their corresponding score ranges:
- 1st quartile (157–163)
- 2nd quartile (151–156)
- 3rd quartile (148–150)
- 4th quartile (133–146)
- No data

Achievement levels (Scores range from 0–300)
- Advanced: 224–300
- Proficient: 167–223
- Basic: 131–166

Source: National Center for Education Statistics, National Assessment of Educational Progress.

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Science and Engineering Indicators 2012, National Science Foundation.
Math, 8\textsuperscript{th} grade

Eighth Grade Mathematics Performance

Figure 8-5
Average eighth grade mathematics performance: 2009

Achievement levels
(Scores range from 0–500)
- Advanced: 333–500
- Proficient: 296–322
- Basic: 222–295

SOURCE: National Center for Education Statistics, National Assessment of Educational Progress.
Science, 8th grade

Eighth Grade Science Performance

Figure 8-7
Average eighth grade science performance: 2009

Achievement levels
(Scores range from 0-300)
Advanced ............... 215-300
Proficient ............... 170-214
Basic ................... 141-169

SOURCE: National Center for Education Statistics, National Assessment of Educational Progress.
What Mathematics Courses Are U.S. High School Students Taking?

Source: CPST, data derived from National Center for Education Statistics
What Science Courses Are U.S. High School Students Taking?

Source: CPST, data derived from National Center for Education Statistics
"Too many students and adults are training for jobs in which labor surpluses exist and demand is low, while high-demand jobs, particularly those in STEM fields, go unfilled."

Retired Raytheon Chairman and CEO, William Swanson, 2011
The Intellectual Capital

According to data from the National Center for Education Statistics for the 2012-2013 academic year:

- International students earned 11.6% of all American doctoral degrees

At the department level International students earned:

- 57% of all doctoral degrees in engineering
- 53% of all doctoral degrees in computer science
- 50% of all doctoral degrees in mathematics and statistics
Is Leaving the U.S.

- China sends the most international students - 31%
- India sends the second most students - 26%
- South Korea is third - 17%

These three countries represent 74% of all international students earning doctoral degrees in engineering, computer science and mathematics in the U.S.
Selected College Majors by Gender

NOTE: Excludes graduates older than 35 at completion of degree.
Women as a Proportion of Selected STEM Occupations, 2005

- Mechanical Engineers: 5.8%
- Engineering Managers: 9.5%
- Civil Engineers: 13.2%
- Aerospace Engineers: 13.3%
- Chemical Engineers: 14.3%
- Industrial Engineers: 14.9%
- Computer Software Engineers: 21.9%
- Computer Programmers: 26.0%
- Database Administrators: 32.3%
- Chemists & Materials Scientists: 35.3%
- Biological Scientists: 48.7%
- Psychologists: 67.3%

Source: CPST, *Professional Women and Minorities*. Data derived from U.S. Census Bureau *Current Population Survey*
U.S. Workforce

U.S. population (left) and U.S. science and engineering workforce (right), by race/ethnicity, 2006
Supply Of Workers Is Low...

- 76M baby boomers will soon retire, and only 51M people are in line to replace them...creating a “worker gap” of 25M. (Pew Center on the States)

- 20% of US workers are functionally illiterate (US Chamber of Commerce)

- Of the 39M young adults aged 17 – 24, 75% do not qualify to join the military (Pentagon)

- More than half of US postsecondary students drop out without receiving a degree. (Center for American Progress/Center for the Next Generation)
...Yet Demand in STEM is High

- In the next 10 years, STEM jobs will grow by 17%, compared to 9.8% for all other occupations.

- Across the US, all occupations, there are 3.6 people for every 1 job. In STEM, there is 1 person for every 1.9 jobs.
And STEM Jobs Are Good Jobs

- Median salary for engineering majors is $91K, the highest of any profession.
Challenge: To Engage Students
Convert Perception of STEM Careers

FROM THIS....... TO THIS......

- Nerd
- Math and science geek
- Must be brilliant
- White male
- Primarily works with machines
- Communicates poorly
- Boring
- Rigid
- Creative
- Enjoys and does well in math and science
- Likes to solve problems
- Works in teams
- Helps people
- Improves the quality of life
- Curious
We Can Do Better!!!

The power of collaboration to raise the bar for all our children globally
Federal Partnerships...
Congressman Kennedy is in!
State by State...
Astronaut, Dr. Mae Jemison is on board!
Taking the message across the globe...

Qatari Educators and Officials from the Supreme Ministry of Education
A Toolkit for Educators

To serve all students
Welcome to NCTL!
Engineering Design on the Exhibit Floor
A New Museum of Science Exhibit Explores ‘The Science Behind Pixar’

It introduces visitors to STEM concepts used in the studio’s animation process with the help of familiar and beloved characters.

By Olga Khvan | Arts & Entertainment | June 26, 2015, 11:50 a.m.
A Leap of Faith...

The Museum of Science soaring to new heights!!
The NCTL Approach

- Standards
- Research
- Curriculum
- Instruction
- Assessment
It’s Elementary...
NCTL K-12 STEM Resources

Elementary

Middle School

High School

District Leadership
NCTL is still working on solutions...
Opening the Gateway
Engaging the Entire Village

- Established in 2005 to support district leadership to build STEM capacity
- Develop a strategic action plan to implement Technology and Engineering in districts to align with science and math
- Served 100+ rural, urban and suburban school districts
- Model for many states to implement (DE, ME, NH, TX)
- Recognized as an @Scale Project by MA
Putting Theory into Practice...

An example from a local school district
Guess Who Makes House Calls...

- School district site visits are opportunities to extend learning and growth
- Offer content-specific professional development
- Support and collaborate with districts on STEM research, PD opportunities, and much more through members-only website
- Relationship building with our districts
A School Visit
Bungie Jumping Barbie

STEM ~ Bungee Jumping Barbies

Today, you will experiment to determine if there is a connection between the number of rubber bands and the number of centimeters Barbie falls.

<table>
<thead>
<tr>
<th># of rubber bands</th>
<th>Centimeters Fallen</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
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- Complete the table above by experimenting. Allow Barbie to bungee jump from different heights in our room. Bungee jumpers DO NOT bump their heads on the ground! Take good care of this doll...or else!
- Record the number of rubber bands as well as the number of centimeters the doll falls.
- We are going to use the data you collect to make a line graph.
- We will then use the line graph to make predictions about bungee jumping at different heights!
Examining Student Work

- 4th grade student engineering design project
- Sketch ideas, design and build solution and communicating their solution by graphing results
Our Impact since 2004

- Reached over seven (7) million students with award winning, standards-based, teacher tested curricula
- Cultural relevant and reflective curriculum development
- On-going teachers professional development and focus on strategic leadership
- 40+ partners nationally & internationally
- External research to measure student achievement and teacher efficacy
Our National Reach...

SINCE JUNE 2009, WORKING IN ALL 50 STATES
And we are moving across the globe...
We teach our students...

Your Dreams
are calling you

Decline  Accept
Thank You!

For more information visit our website at: www.mos.org/nctl

Contact me directly at: yspicer@mos.org

@DrYvie