THIRD ANNUAL NACME CONTINUUM MEETING
SEPTEMBER 30—OCTOBER 1

JOINT CONGRESSIONAL STEM SESSION
OCTOBER 2

2013 NACME NATIONAL SYMPOSIUM
TAKE ACTION: CHANGING STEM EDUCATION FOR URMS THROUGH RESEARCH AND POLICY
OCTOBER 1–3
# 2013 NACME Symposium Research and Policy Journal

## Table of Contents

1  **Message from President and CEO of NACME**

2  **Congressional Letters of Support**
   - 2  Speaker of the House, The Honorable John Boehner and The Honorable Lamar Smith
   - 3  Minority Leader of the United States House of Representatives, The Honorable Nancy Pelosi
   - 4  The Honorable Eddie Bernice Johnson
   - 5  The Honorable Marcia Fudge
   - 6  The Honorable Roger Wicker, The Honorable Richard Durbin, The Honorable Mark Kirk, and The Honorable Jeanne Shaheen
   - 7  The Honorable Kirsten Gillibrand

8  **Message from Secretary of Energy Ernest Moniz**

10 **2013 NACME Continuum Meeting**

13 **Special Joint NACME – Congressional Session:**
   - Advancing URMs in STEM Education and Careers
14  Panel 1 – The “New” American Dilemma Defined: A Data-Based Look at Diversity in Engineering
19  Panel 2 – Regional Public/Private Partnerships in STEM Education: Best and Promising Practices

29 **Written Testimonies on the Special Joint NACME – Congressional Session**
   - 30  Beatrice J. Arvie
   - 33  Legand L. Burge, Jr., Ph.D.
   - 38  Eileen M. Campbell
   - 41  Stacey DelVecchio
   - 43  Richard Kazis and Carol A. Lincoln
   - 48  Janet Bandows Koster
   - 51  Madiha Kotb
   - 52  Rebecca B. Ramos
   - 55  Brittany Wilkins

57 **White Papers and Comments Offered at the 2013 NACME National Symposium**
   - 57  NACME National Symposium General Session I: Catalyzing the Engineering Pathway for URM Students
   - 65  NACME National Symposium General Session II: The College Affordability Crisis
   - 77  NACME National Symposium General Session III: The Mathematics Conundrum
   - 91  NACME National Symposium General Session IV: Innovations in STEM Teaching and Learning
   - 111  NACME National Symposium General Session V: Shaping Engineering Public Policy
   - 119  NACME National Symposium General Session VI: Ensuring a Diverse Engineering Workforce

129 **NACME Board of Directors**

130 **NACME Partner Universities**
Dear Colleagues,

I am delighted to present you with the 2013 NACME Symposium Research and Policy Journal. This publication contains transcripts, white papers, and testimonies from the impressive roster of participants in the 2013 NACME National Symposium and Third Annual Continuum Meeting, held on September 30 – October 3, 2013 in Washington, D.C. For this spectacular event, the National Action Council for Minorities in Engineering, Inc. (NACME) assembled some of the world’s most notable leaders from business, K-12 education, higher education, and government.

The theme for the 2013 NACME National Symposium was, “Take Action: Changing STEM Education For URMs Through Research and Policy.” This theme continues the discussions catalyzed at the 2008 and 2011 Symposia held in Vienna, Va., and St. Paul, Minn., respectively. In previous Symposia we have issued Calls to Action to our partners in K-12 education, higher education, government, and business designed to resolve the “New” American Dilemma.

This impressive document contains original research and introduces strategies that represent the kind of out-of-the-box thinking required to address the obstacles and opposition facing underrepresented minority students in science, technology, engineering, and mathematics (STEM) education and career fields.

NACME’s decision to hold this event in our nation’s capital was intended to connect our outstanding research efforts and programs to the need for legislative action that would ensure impact. Policymakers require enhanced links between research and policy in order to avoid the kind of policies that are unlikely to attain their objectives. Rethinking STEM education and workforce development policy in the context of increasing diversity with equity, and on the basis of a revitalized research-policy nexus, requires relevant knowledge to be produced and made available to policymakers in forms they can understand and use.

Despite the mandated government shutdown that took place on the eve of the Symposium’s kick-off, which precluded the joint Congressional STEM Session planned for Capitol Hill, NACME was still able to hold two focused discussions on: a Data-Based Look at Diversity and Engineering, and Best and Promising Practices in Regional Public/Private Partnerships in STEM Education. The Symposium audience was also invited to submit testimony to Congress on ideas for resolving the “New” American Dilemma. NACME and its guests were fortunate enough to receive a welcome message from the U. S. Secretary of Energy, Ernest Moniz, during the opening dinner for the Symposium. Secretary Moniz recorded what would have been his opening keynote speech for the Symposium just hours before the mandated shutdown.

This final report from the 2013 NACME National Symposium challenges existing paradigms and reframes the research-policy nexus for change and action in Catalyzing the Engineering Pathway for URM Students, Mathematics Education, STEM Teaching and Learning, Engineering Public Policy, and Engineering Workforce Development.

Cordially,

Irving Pressley McPhail, Ed.D.
NACME President and Chief Executive Officer
October 2, 2013

Dear Friends,


The efforts and focus of NACME on the future of our national STEM workforce is greatly appreciated. Members of Congress are also committed to strengthening a competitive STEM workforce.

Your contribution to this national debate through this symposium is critical. Our colleagues can look forward to hearing your thoughts and visions on effective initiatives to expand participation in STEM fields.

Thank you for NACME’s commitment to the most basic American value of ensuring opportunity to everyone in every field of endeavor. Our nation excels not only because of our heritage of technological and engineering greatness, but also because our people are free to build, innovate, and prosper.

Sincerely,

John A. Boehner  
Speaker of the House

Lamar Smith  
Chairman, Committee on Science, Space and Technology
Dear Friends:

It is my great honor to bring you greetings on the occasion of the National Action Council for Minorities in Engineering (NACME) biannual Symposium.

Thank you to the National Action Council for Minorities in Engineering for working tirelessly to ensure that the engineering workforce in the United States is composed of men and women from diverse racial and ethnic backgrounds. Eliminating disparity in our education system and in scientific careers will help reignite the American Dream.

Education is the best investment parents can make in their children, individuals can make in themselves, and a nation can make in its future. It is imperative that we maintain our public commitment to fund science, technology, engineering, and mathematics (STEM) education and provide federal investment into funding for science.

Thank you for all that you do. Again, congratulations and best wishes for a memorable and successful symposium.

best regards,

NANCY PELOSI
Democratic Leader
September 10, 2013

Dr. Irving McPhail
President
NACME
440 Hamilton Ave, Suite 302
White Plains NY 10601-1813

Dear Dr. McPhail:

It is a pleasure to welcome NACME and all of the NACME Board and Symposium participants to Washington, D.C. I have worked closely with NACME on our shared commitment to advance and expand minority opportunities in the STEM engineering, science and technology arena, and greatly value the critical analyses and research that NACME provides in this arena.

It is an exciting time for you to be in Washington as we are in the process right now of considering a variety of proposals to reform and advance federal efforts in STEM, and particularly on their impact on our focus on minority participation in STEM. To address this issue I introduced, H.R. 1358, STEM Opportunities Act of 2013, and hope to see this legislation advanced with your support.

I cannot emphasize enough the importance of science, technology, engineering and mathematics (STEM) disciplines. As you are aware, as a country we have been falling behind other nations in Math and Science education for several years now. The number of scientific papers published by Americans is declining. Americans are receiving fewer Nobel Prizes in the sciences. There is evidence that the foundation of our innovation-based economy is experiencing dangerous deterioration. For America, this is unacceptable.

In order for us to become energy independent, create new jobs, develop innovative exports, and develop the next great technological feat, we must have a well-trained workforce that is proficient in science, technology, engineering and math. I am thrilled that you are taking the time to participate in NACME’s symposium and to share your thoughts and visions for ever more effective STEM initiatives that especially focus on the challenge and the potential of advancing minorities within the STEM arena.

I am proud to be a strong supporter of NACME’s efforts and look forward to continuing to work closely with the NACME community. I congratulate you all for your participation and wish you much continued success.

Sincerely,

Eddie Bernice Johnson
Member of Congress
September 27, 2013

As the Chair of the Congressional Black Caucus (CBC), it is my pleasure to welcome the National Action Council on Minorities in Engineering (NACME) to Washington, D.C.

The CBC views the NACME as an important voice in the dialogue surrounding our future federal STEM policy and funding investments. I share NACME's commitment to advancing and expanding minority opportunities in the STEM engineering, science and technology arena and greatly value the information and resources that NACME provides.

As you may know, I have introduced H.R. 1343, the Project STEM Ready Act. I hope you will support this measure as part of your agenda. I also hope you will continue to support and advocate for the other pending legislative proposals that reform, advance and fund federal efforts in STEM and that will help increase minority participation in STEM programs.

Thank you for your commitment to improving STEM and to advancing minority participation. I am proud to be a strong supporter of NACME and I look forward to working with you in the future.

Sincerely,

Marcia L. Fudge
Chair, Congressional Black Caucus
October 2, 2013

Dr. Irving McPhail  
President and CEO  
National Action Council for Minorities in Engineering  
440 Hamilton Avenue, Suite 302  
White Plains, NY 10601-1813

Dear Dr. McPhail,

As co-chairs of the Senate STEM Education and the Workforce Caucus, we are honored to welcome the National Action Council for Minorities in Engineering (NACME) to Washington, D.C., for your 2013 symposium.

We applaud NACME’s efforts to advance Americans of diverse backgrounds in STEM-related careers. NACME brings an important voice to the conversation about STEM education and the workforce, and we appreciate your organizing this event in the United States Capitol to address these issues. Bringing industry and education representatives to our nation’s capital to discuss the challenges facing minorities in STEM fields is essential to finding innovative solutions.

Thank you for your dedication to promoting a diversified STEM workforce. We wish you the best of luck with your symposium and look forward to working with you in the future.

Sincerely,

Roger F. Wicker  
United States Senator  

Richard J. Durbin  
United States Senator  

Mark Kirk  
United States Senator  

Jeanne Shaheen  
United States Senator
Dear Friends,

It is a privilege to send greetings to everyone attending the National Action Council for Minorities in Engineering’s Bi-Annual Symposium. It is inspiring that so many leaders from various sectors are coming together for such an important issue.

I am grateful to NACME for their steadfast commitment to advance and expand minority opportunities in the STEM engineering, science and technology arena. It is your dedication that supports students in building the skills, imagining the future, developing the character and exercising the courage that will lead them to discover and pursue their passions. It is my hope that your efforts inspire others to take part in actions large and small, public and private to enhance the well-being of those in our community.

The encouragement NACME provides for all Americans, specifically students of color, to be leaders in STEM is critical. Increased participation in science, technology, engineering, and math is the key to help prepare our students with the skills and training they need not just to meet the demands of the economy of the future, but to lead us there.

I will continue to work on advancing minorities in the STEM arena and look forward to the continued support and dedication from organizations like NACME. Please accept my best wishes for a wonderful event and many more years of success.

Sincerely,

Kirsten E. Gillibrand
Kirsten E. Gillibrand
United States Senator
Hello, I’m Secretary of Energy Ernest Moniz. I want to thank Board Chairman Art Burson for inviting me to speak, and for his leadership here at NACME. I also want to recognize Dr. Percy Pierre, the first African American to receive a Ph.D. in electrical engineering and one of the founders of this organization. I also want to thank the National Action Council for Minorities in Engineering as a whole. The work that you do has, for decades, helped attract minority students to STEM careers and your scholarships help them pay for the education they need to join your ranks.

All of us in the energy field—public, private, and academic, benefit from the pipeline of talent that you provide. NACME ranks at, or near, the top in terms of impact on college level minority education.

As so many of you know, engineering in this country has long been an important pathway for social mobility, a ticket to the middle class for those willing to work hard and pursue the American dream.

I’ve enjoyed the opportunity to work with NACME in the past, such as when I served at the Office of Science and Technology Policy and I welcome this opportunity to reengage.

I very much regret being unable to deliver these remarks in person, but as you know Congress has not been able to provide funding to the federal government, so any activities are restricted until Congress carries out this responsibility. In thinking about these remarks, I thought back to a small book that made a big impression on me, The Existential Pleasures of Engineering by Sam Florman, first published in 1976 when I was a young academic. I won’t rehash Florman’s argument for engineering as a great profession—one that addresses the human impulse to shape our environment for both public and private benefit and satisfaction—but I would highlight one point from the book, one that I felt very much during my MIT career, the democratizing power of engineering as a profession. As so many of you know, engineering in this country has long been an important pathway for social mobility, a ticket to the middle class for those willing to work hard and pursue the American dream.

This is an exciting time for the energy world. In the last five years we have seen domestic energy production surge. Oil imports are at the lowest level in 20 years and natural gas production is at its highest point ever. We’ve also seen the production of clean energy rapidly expand. Renewable electricity generation from wind, solar, and geothermal sources has doubled and carbon emissions have fallen to the lowest level in the U.S. in nearly two decades. The cost of solar, wind, LED’s, and electric vehicle batteries have fallen dramatically and deployment is sharply up. We are at an inflection point on the issue of energy and climate change. This is not only an environmental issue it’s a multi-trillion dollar global business in the making. Markets are forming around the solutions we need to generate clean power, around the wind and solar industries, around nuclear and natural gas, and advanced fossil fuels. It’s an opportunity for America to lead. However, we can’t address the challenges and opportunities unless we have the very best and brightest in this country working on these issues. And the American economy won’t be able to compete in the global marketplace unless we ensure that the next generation of scientists, engineers, technicians, entrepreneurs, and others are the most qualified that the U.S. has to offer.

It’s no secret that women and minorities are underrepresented in the energy field. Hispanics, African Americans, and American Indians make up 24 percent of the overall American workforce, but they account for only nine percent of the workforce in science and engineering.
Right now women and minorities make up 70 percent of college students, but only 45 percent of undergraduate STEM degree holders and today the majority of young children are minorities. Economists expect 2.4 million job openings in STEM between now and 2018. These are good paying jobs and we need more women and minorities ready to fill these positions. We all need to do more to engage with women and minority communities. This is a business imperative, diversity imperative, and a moral imperative. This is why when I arrived at the energy department I directed our department to launch the new Minorities in Energy Initiative, with our Director of Economic Impact and Diversity, Dot Harris, in the driver seat. This program seeks to inspire underrepresented Americans to pursue careers in energy and support their advancement into leadership positions. Later this fall, the White House will host a briefing to introduce 20 new Minorities in Energy Ambassadors. These will be senior level leaders pushing for inclusion, access, and engagement by minorities in the energy sector. These ambassadors will also help us launch the second part of this program, The Minorities in Energy Awards. These annual awards will highlight individuals who are advancing minority participation in the energy sector.

Hispanics, African Americans, and American Indians make up 24 percent of the overall American workforce, but they account for only nine percent of the workforce in science and engineering. I had the privilege to serve on the MIT faculty for 40 years with the occasional wandering off to government service. I understand the importance of a meritocracy. In science and engineering it is crucial that people are judged based on the power of their ideas not by the color of their skin, their age, or by their gender. This is the beauty of science, technology, engineering, and math. We must continuously insist that these principles apply to hiring decisions, to R&D opportunities, and to access to leadership positions. This is why I am committed to promoting diversity and inclusion at the Department of Energy and in the energy field. President Obama has directly endorsed this focus as one that is critical for developing American talent and strengthening our economy and our society. This is why the Department of Energy is committed to ensuring that the energy workforce of the future reflects the diversity and strengths of this great nation. Thank you for all your hard work and enjoy the evening.
Vision
The Continuum meeting aligned itself with NACME’s strategic plan to strengthen and extend our linkage among our partners and to increase substantially the number of underrepresented minorities (URMs) graduating high school prepared to pursue engineering education and respond to the demand for highly skilled technology workers. NACME wishes to be the unifying force that connects like-minded individuals and organizations committed to diversity with equity in STEM in the national effort to confront and resolve the “New” American Dilemma.

Purpose
The 2013 NACME’s Continuum Partner Meeting was conducted with the goal of providing a forum for sharing in NACME’s program achievements through partnerships.

Background
NACME has learned from its program operations experience. We understand that obtaining an engineering baccalaureate degree requires a multifaceted strategy. Scholarships alone do not suffice. Our program goals are accomplished through our partnerships across the educational continuum. NACME has forged a direction that focuses on an education continuum that:

- Establishes and deepens engagement through partnerships;
- Builds institutional capability;
- Learns from our programs; and
- Transfers and adapts knowledge.

In 2003 NACME launched the NACME Scholars (Block Grant) program with the goal of focusing on a selection process that identifies institutions that demonstrate their capacity to recruit, admit, retain, educate, and graduate URM engineering students.

In October 2010, NACME conducted a joint pre-college and NACME Partner Universities meeting with the aim of increasing awareness about NACME’s engagement in the pre-college arena and initiating a dialogue focused on developing a strategy that links high school graduating seniors to NACME’s University Partners. The participants included:

- Middle/High School: teachers, principals, parents, guidance counselors, and students;
- Community College/University: Administrators, faculty, and students;
- Corporate representatives;
- NACME Board Members; and
- Government agencies.

Recommendations from the group focused on the need for more information about NACME’s nationwide pre-college program and university partner relationships. There was a consensus that NACME ought to facilitate connections by providing contact information and holding annual joint meetings with the goal of sharing best practices and refining the linkage among our constituents. In the last two years NACME has facilitated the connection among key stakeholders by launching two STEM Integration Model pilot projects.

The first two NACME STEM Integration Regional model programs were launched as follows:

- New York and New Jersey regional STEM Integration Model—implemented in 2012; and
- Texas regional STEM Integration Model—year of planning 2013.

In an effort to broadly communicate the impact of our programs, the 2013 Continuum Meeting sessions featured various aspects of NACME’s program outcomes. In addition, select individuals were invited to make presentations to expand the engineering pathways for underrepresented minorities.

Theme
Connectivity 2013: NACME’s Programs and Services Catalyzing Systemic Change in the Engineering Workforce Continuum—Middle School through Workforce Entry

Audience
- University: Administrators and faculty/Community College
- Middle/High School: Teachers, principals, parents, and guidance counselors
- Corporate representatives
- NACME Board Members/liaisons
- Government agencies

Expected Outcomes
- Increased awareness about NACME’s programs and impact
- Sharing of four, five, and six year graduation rates at NACME Partner Institutions that have been awarded a grant
- Sharing of best practices from industry leaders

Meeting Takeaways
- Provide the audience with a deeper understanding for how NACME develops accountability partnerships with academic institutions
- Provide leading edge reports and a forum for discussion focused on best practices for increasing academic institutions’ capacity to recruit, admit, retain, educate, and graduate underrepresented minority students
2013 NACME Continuum Meeting

Agenda

**Date**
Monday, September 30 to
Tuesday, October 1, 2013

**Location**
Washington Marriott Wardman Park Hotel
2660 Woodley Road NW
Washington, D.C. 20008

**Monday, September 30, 2013**

**Implications for Fisher v. University of Texas at Austin and Beyond**
Keynote Speaker
Sharon L. Davies, J.D.
Executive Director
Kirwan Institute for the Study of Race & Ethnicity
John C. Elam/Vorys Professor of Law
Moritz College of Law
The Ohio State University

**Tuesday, October 1, 2013**

**NACME Scholar Program Update**
Aileen Walter
Vice President
Scholarships and University Relations
NACME, Inc.

**Christopher Smith**
Director
Research and Program Evaluation
NACME, Inc.

**Centers of Excellence for the Graduation of Underrepresented Minority Engineering Students**
Felicia Benton-Johnson, Ph.D.
Director
Engineering Education Outreach
Georgia Institute of Technology

**Scott Pinkham**
Academic Advisor, Minority Student Engineering Program
University of Washington

**Bevlee Watford, Ph.D., P.E.**
Associate Dean for Academic Affairs and Director
Center for Enhancement of Engineering Diversity
Virginia Polytechnic Institute and State University

**Expanding Underrepresented Minority Participation: America’s Science and Technology Talent at the Crossroads**
Earnestine Psalmonds Easter, Ph.D.
Co-Study Director
National Science Foundation

**Moderator:**
Dwight Tavada
Kettering University

**Spatial Skills Intervention to Improve Student Success**
Susan Staffin Metz
Director of Diversity and Inclusion
Principal Investigator
EngageEngineering.org
Stevens Institute of Technology
Moderator:
Janice M. Zdankus
Hewlett-Packard Company

**Panel Presentation NY/NJ regional STEM Integration Model**
James R. Bryant
Texas Regional Coordinator
NACME, Inc.

Sarah Xayarath Hernandez
Director of Diversity
College of Engineering
Cornell University

Laurence Anthony Howell
Executive Director
Educational Opportunity Program
New Jersey Institute of Technology

Bill Taylor
Associate Vice President
Network Engagement and Growth
National Academy Foundation Network of Career Academies

**Where Are All The STEM (Science, Technology, Engineering and Mathematics) Students?**
Ryan Munce
Vice President, Strategic Alliances
National Research Center for College & University Admissions

**Overview of NACME Symposium and Wrap-Up**
Aileen Walter
NACME, Inc.
Fueling the American Dream.

Through a culture of inclusion, The BP Foundation fuels academic achievement. As a founding sponsor, we’re pleased to help NACME provide scholarships for African-American, Latino and Native American students pursuing STEM education. We’re honored to support the 2013 NACME National Symposium.

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Dear Symposium Attendee:

You are coming to Washington at a very challenging time.

Federal Fiscal Year 2013 will come to an end at midnight, Monday, September 30th. By the time you arrive in Washington for our NACME Symposium, or shortly thereafter, we will know whether there will be a shutdown of the Federal Government.

There are four (4) days and roughly 20 hours left before a shutdown will have to be implemented, and at this very point in time, there is no agreement on a spending plan and budget for FY2014. Once again, Congress, the Administration and all of its agencies, and the country will be facing a possible government shutdown, or at a minimum another short-term Continuing Resolution to just keep the agencies and programs so important to our mission and your interests operating.

Extremely critical discussions will be going on at the national level, while you are here; and key decisions will be made at the very same time that the NACME Symposium is being held. This does make it an especially critical time to be in Washington, providing your input and ideas as they seek to finalize federal policies, programs and spending plans for STEM, and particularly Minority STEM initiatives.

NACME is committed to making your time and participation here not only very relevant to these unfolding developments, but to also provide you with an opportunity to participate directly in the process.

We are convening a special joint NACME- Congressional Session focusing specifically on Minorities and the Federal STEM Initiative. It is being called specifically to provide NACME Symposium participants with a platform through which you can share your thoughts and visions for ever more effective STEM initiatives that are focused especially on the challenge and the potential of advancing minorities within the STEM arena. For, while there has been a great deal of attention on STEM at the federal level, there has been relatively limited focus on the need to especially support policies and programs that recognize the importance of advancing minorities in the STEM arena.

NACME is dedicated to ensuring that federal policy does focus on this unmet challenge. We hope this congressional hearing will help us advance your key goals and objectives; will better inform Congress on not only the critical need and challenge; but also inform them of important initiatives and models that NACME and Symposium participants are exploring.

It is being sponsored by a bipartisan and bicameral number of Congressional Members who will play key roles in the authorization and funding of federal STEM programs in leadership and key committee roles. It will be taking place at just the right time, we hope, to influence the decisions that will be made on federal STEM policy and funding at just this point in time.

Speaker Boehner’s office arranged for our session to be held in the U.S. Capitol, and with the Chairman of the House Science and Technology Committee, has sent NACME a special letter supporting this event and its importance. The session will be led by Congressman Eddie Bernice Johnson, who serves not only as the head of the House Diversity and Innovation Caucus, but is also the senior-most Democrat on the House Committee for Science and Technology; and is the author of our key bill, “Expanding Minority Participation in STEM”, which highlights NACME.

Symposium attendees will not only be witnesses, but all Symposium attendees will be encouraged to submit written testimony on the views and recommendations for the record which will then be shared with all participants, and with key congressional leaders, committees, and special congressional caucuses involved in federal STEM policymaking and funding decisions.

We have provided you with the following materials that we hope will add to your enjoyment of this session:
• The Program and Panels
• Biographical Background on Selective Members of Congress Participating
• Guidance on Submitting Your Testimony on Minority STEM Needs, Policies, Proposals
• Special Congressional Letters to NACMEEndorsing the Symposium, Key Objectives
• Summaries of Major STEM and Minority STEM Legislation in which NACME Actively Involved
• List of Key Congressional Committees, STEM Caucuses Responsible for STEM Policy and Funding at the Federal level.

Please plan on attending and participating in this important event on Capitol Hill. It will be held in the U.S. Capitol, in the Capitol Visitors Center, the Congressional Auditorium on the afternoon of October 2 from 2:00-4:30 p.m.

Sincerely,

Marilyn A. Berry Thompson
Chair, MWW Group
Federal Practice and Federal Policy Advisor to NACME
Panel number one will include a corporate representative, as well as an executive from the engineering sector. Unfortunately our panelist from the National Science Foundation is not able to be here with us. The panel discussion will be followed by a question and answer period. We will then move to the second panel. The second panel will be chaired by my inimitable colleague, Saundra Johnson Austin, Senior Vice President for Operations at NACME. That panel will focus on the regional STEM integration model.

Beginning with Chart #1: By 2050, as this chart clearly indicates, there will no longer be a majority race in the United States. The Latino population, of course, is expected to continue to grow rapidly while the percentage of Asian Americans and Americans who identify with two or more races is expected to slightly increase. The percentage of African Americans, American Indians/Alaska Natives, and Latinos is expected to remain relatively constant, while the percentage of Caucasians is expected to significantly decrease. These shifting demographics are evident in the 2012 U.S. population. While Latinos comprise 17 percent of the overall population, they represent 20.7 percent of college age students and 23.2 percent of those aged between 5 and 17. Underrepresented minorities represent 31.2 percent of the overall population, 38.1 percent of college-aged students and 39.9 percent of elementary and secondary school age students.

In total NACME Partner Institutions awarded 29.7 percent of all engineering bachelor’s degrees to underrepresented minority students in 2011.

Now, to some of the challenges in the pre-engineering domain. Pre-college preparation is a major issue for URM’s on the elementary and secondary levels. Here we see that on the National Assessment of Educational Progress, otherwise known as NAEP, only 32 and 41 percent of African Americans and Latinos, respectively, earn a score that reflects a moderate understanding of complex procedures and reasoning. That is 300 or above, compared to 70.5 percent of white students. The numbers are similarly disparate for scores reflecting higher level functioning at 350 or higher, such as multi-step problem solving and algebra. And for all of you engineers and for all of us engaged in various aspects of engineering education it’s somewhat logical to suggest that the higher order mathematics skills would be very relevant and very important for one to be successful in engineering education and engineering careers.

Moving on there is a similar divide seen on the NAEP science scores for science for 4th, 8th, and 12th grade students. Underrepresented minorities earned the lowest scores at all three grade levels with African Americans in particular earning significantly lower scores than their peers on the 12th grade test.

SAT and ACT scores are often a gateway to a premier post-secondary institution. Here, you see that the mean math SAT scores for African Americans, Latinos, and American Indian and Alaska Native students are significantly below the national average and especially insufficient for those who aspire to be engineers. Math and science scores on the ACT are displayed here disaggregated by race. Similar to the other standardized test score results, underrepresented minorities score lower than their peers on this test, with African Americans earning the lowest scores.

Now to persistence to graduation in undergraduate engineering programs. Many challenges exist for underrepresented minority students who enroll as undergraduate STEM majors, and the
retention rates for those students are low relative to their peers. The percentage of first year engineers who are underrepresented minorities is 17.3 percent and by the fifth year this percentage drops to 12.2 percent. Getting depressed yet? I am.

Underrepresented minorities earned only 12.5 percent of the engineering bachelor degrees awarded in 2011. They also earned 7.2 percent of engineering master’s degrees, and 4 percent of doctoral degrees. These numbers are miniscule for underrepresented minority female students who earned 2.9 percent of bachelor degrees, 2 percent of master’s degrees, and 1.2 percent of doctoral degrees in the field of engineering. The precollege and post-secondary challenges that were outlined have a cumulative impact on the engineering workforce. Underrepresented minorities comprised 10.2 percent of employed engineers in 2010 and slightly more than 6 percent of all engineering faculty members. While women comprise 50.8 percent of the overall population and 57 percent of the total undergraduate enrollment, they earned only 18.8 percent of engineering degrees in 2011, and made up 12.7 percent of the overall engineering workforce.

Now, let’s drill down for each of the groups that are represented by NACME. First, African Americans: African Americans made up 3.6 percent of the engineering workforce and 2.5 percent of the engineering faculty despite making up 13.4 percent of the total undergraduate enrollment and 12.3 percent of the overall American population.

Now to American Indian and Alaska Native students: Even though this category of students represents a smaller percentage of the population, American Indian and Alaska Natives are still underrepresented in engineering. Despite making up 0.8 percent of the total undergraduate enrollment and 0.7 percent of the total population, American Indian and Alaska Natives earned 0.4 percent of engineering bachelor degrees in 2011 and made up only 0.3 percent of the engineering workforce and 0.2 percent of all engineering faculty. Latinos are, of course, the fastest growing ethnic group in the country and comprise 17 percent of the overall U.S. population. Despite this fact, as the data indicates, they earned only 8.1 percent of the engineering bachelor’s degrees in 2011 and made up 6.3 percent of the engineering workforce and 3.7 percent of engineering faculty. In 1974 [when NACME was founded] approximately 2 percent of all U.S. engineers were underrepresented minority students. In our current year that percentage has grown to 10 percent. But when you think about a growth of 2 percent to 10 percent, and then you think about the raw numbers of these groups in the U.S. demographic, clearly, although we have made progress, the growth has been marginal and does not come near to proportionality.

Our institutions serve as models of best practice in developing an environment that supports and embraces not only diversity but also positive learning outcomes.

Now let’s talk a little bit about our NACME Scholars and our institutions. We are proud at NACME to be associated with 51 major institutions that provide engineering programs at both the undergraduate and graduate levels. You also know that underrepresented minority students earned approximately 9,736 engineering bachelor degrees in 2011. Our NACME Block Grant institutions awarded 20.3 percent of these degrees while NACME affiliate institutions awarded 9.4 percent. Thus, in total NACME Partner Institutions awarded 29.7 percent of all engineering bachelor’s degrees to underrepresented minority students in that year. I think that is something to celebrate. So a shout out to our 51 partner institutions, our MEP’s, our presidents, and our deans of engineering.

Moving to the next chart, when examining institutions that awarded the most bachelor’s degrees to minority students in the year 2011, we see that six of the top 10 institutions were in fact NACME Partner Institutions. Our institutions serve as models of best practice in developing an environment that supports and embraces not only diversity but also positive learning outcomes. Let me end with an announcement to some, and perhaps a continuing conversation for others. We are proud at NACME to have been awarded a major three-year grant by the National Science Foundation. I call it “The Big Study.” It has a fancier name, and we can talk about that off-line, but for me it is The Big Study. And the purpose of The Big Study is to do a very big thing. And that is to take an intensive look at the factors that seem to account for the outstanding track record of the network of universities that appeared on the earlier slide, in recruiting, enrolling, educating, retaining, and graduating our students—underrepresented minority engineering students. Our intent is to look at the 31 institutions from that group of 51 that are a part of what we call our NACME Block Grant universities. The 31 NACME Block Grant universities are those universities that receive scholarship dollars directly from NACME, which they then use to recruit, enroll, educate, retain, and graduate increasing numbers of URM students.

Dr. Jacqueline Fleming, a distinguished researcher and an expert in qualitative and quantitative research methods applied to minority student education, is the PI for the study and a plenary speaker at tomorrow’s program. This is a collaborative research project that especially salutes the courage and ingenuity of our Minority Engineering Program Directors (MEPs) and other key campus stakeholders.

That’s the overview, that’s the context, that’s where we stand today. You’ll get a lot more context as we delve into the data and the depth of information provided in the 2013 NACME Data Book. Now, it gives me great pleasure to bring up Panel #1, a panel that will react in their own unique way to the data and to the general issues surrounding where we are today with regard to an engineering workforce that looks like America.

I am pleased to introduce a person who is very, very special to me, my first boss, as Chair of the NACME Board of Directors, Eileen Campbell, who is Vice President for Public Policy at Marathon Oil Company, and the founding chair of the NACME Public Policy Committee. She is a stalwart advocate for all of the issues and...
Dr. Katherine “Kitty” Dideon
Senior Program Officer
National Academy of Engineering

Good afternoon. It’s an interesting time to be in D.C. and the title of this session is Take Action, but I would like to argue that there’s action that we can take beyond just engaging our congressional and federal colleagues. In fact, there’s action we can take within our own institutions as well as within our own regions and areas.

How many of you are familiar with the National Academy of Engineering (NAE)? So, most of you know that we are technically a nonprofit. I’ve had a few calls about why aren’t you closed, and the fact is in 1863 when we were created by charter by Abraham Lincoln, we were created to be an entity to give scientific and technical advice to the government, but not be part of government and I guess that’s why, while we are not technically a part of the government, we do a lot of work on behalf of the government and congressional requirements as well. And in fact NACME grew out of the effort of NAE and others, and we’re very proud to continue this relationship with NACME and our colleagues. And, what many people don’t realize is roughly 45 percent of the academies are in industry, so we enjoy a unique perspective, having people in engineering who are from the industrial sector, as well as the academic sector and the government sector. I think it’s that perspective that can address some of the issues that my colleagues have raised today.

So I want to “Take Action” and I want to talk about what I think is a community that many of us can be addressing and that is what’s happening in our two-year community colleges. I know that Dr. McPhail is a former president of a community college and many of us around the table, many of our industrial members may be employers who may have recruited colleges, but frankly this is something that NAE has struggled with, about how we address these issues. So I have things that I want to share with you and I want to put in perspective. And what I want to talk about is when we start looking at a viable work force we have to be thinking about where students are, how we help create pathways to where they can go. But the other issue that we often don’t hear raised is that we hear a lot about recruitment. You don’t hear a lot about retention and advancement, and I think that’s another area in particular where we’re thinking about those pathways and what we can do. NAE has right now a report that’s about to come out looking at the diversity in the industrial workforce and it has some data in it that probably some of you have seen and others have collected. One of the things that’s really interesting is if you look at that data broken down by field, i.e., engineering, by race, ethnicity, and gender, you will find there are differences in key actions and activities done by those in the engineering sector. So I think part of the thing that we need to think about is not only how do we prepare the workforce, but then how do we create an environment so that they can have the personal success that will benefit our nation.

That’s my hope on what to do in about 15 minutes. So, I’ll be very quick. Engineering and engineering technology are two broad fields that often have not been considered, particularly engineering technology which has a two-year program. So we were really interested in what was happening in terms of transfer students. The National Academy of Engineering did a report in 2005 about community colleges and one of the things talked about was do we really know what happens to two-year engineering students? Do they go to four-year schools or what happens? And there wasn’t a lot of data. If we don’t have good data that can help us understand this we’re not going to have good federal policies, and we’re not going to have good state regulations that will help our students. So our focus is really to understand better what is happening with these students. One of the things that surprises a lot of people is that there are a lot of two-year schools. And not all of them are the same. We have tribal two-year schools, and we have public, and we have independent two-year schools. We have a lot of students enrolled; many of them not for credit, but many of them for credit, and 60 percent of them are part time. And this becomes a terrible challenge when you start talking about at what point do you say you’ve gotten a BS degree in engineering. And I can remember having just an amazing conversation with the Dean of Engineering at San Jose State saying, “Kitty, all of our engineering students are part time, they all work and go to school. So how do you expect them to have a degree within six years? Your whole measure of success is not right.” And so one of the challenges we have to think about is what is appropriate in helping our students get that degree and finding that job in engineering within an appropriate time frame.

The other thing that I think is really interesting is that the actual median age for two-year schools has been going down because we have more students going to two-year schools trying to get into four-year state schools of choice with more articulation programs. So there’s a huge difference. You have some students who are going there explicitly to get a two-year degree, some who are going for credit for a four-year or another institution, and you have some going for non-credit. What’s intriguing is 42 percent of those at two-year schools are first generation in their family to go to a university. So, they are often, you could say, going to sea without a map. They don’t necessarily have the information they need to understand how they can be successful. So just very briefly, I know it’s been a long day and I don’t want to throw a lot of data at you, but we started thinking about how we could do a pilot study looking at different kinds of data so that you can see what some of the issues are. One of the things I learned in the process is that very few private schools, private four-year universities, take large numbers of engineering transfer students, perhaps fewer than a dozen. One of the schools that actually does, believe it or not, is Cornell. They take over 100 students a year. But very few others do, so most of the institutions we are working with or talking about are public universities because they’re usually the ones that are set up to take engineering transfer students. The other thing is that there are a lot of differences between states. This is where state issues come into play as well as relationships. I had conversations with some very interesting two-year schools in Florida and they said, well, we send a lot of students to Georgia Tech. I was ready to hear the University of Florida or Florida State, and so I said, wait, Georgia Tech, how did that happen? It was a personal relationship that got developed, the caliber of these student
were known, so you have a lot of these kinds of anomalies about how these things are done. But what we are really trying to say is, is there a framework that can help us understand some of this? So, there’s no quiz, but just to give you an idea very quickly. There are several NACME partner institutions on this list, but we have a very broad group of institutions geographically as well as types that surveyed the material and these will be available for you later.

Our partner institutions are all over the place, Minnesota, Iowa, and many other places as well. And what we were trying to find out is, what we might learn about engineering and engineering technology collected in many formats and for many reasons. It’s often only collected if there is a hierarchy or leadership that says there’s a value in this; particularly if there is state funding affiliated with it. And there are some states, like Texas, which I think is well represented in this room, that are starting to require this collection. But at the time, it was very episodic about how the data was collected and what the value that data was. And in most cases, the data was only used internally. There wasn’t an opportunity to understand how that data was shared, and it wasn’t necessarily being reported to the stakeholders, the students themselves, or their parents, or anyone else that might be affected.

So what we found is that there was really a black hole around the data for the two-year students. So this is just from our representation. I think it matches nicely with what Dr. McPhail did. I just want to point out two things: that the population in two-year schools is different from the population in four-year schools in terms of a greater representation of underrepresented minorities. Now when you go into engineering and engineering technology it goes down, but one thing that really hasn’t been addressed is that engineering technology has a very significant representation of African Americans, particularly African American males. And there are some long historic connections that I don’t think we’ve really utilized about how we can encourage students to look at more engineering programs and learn from some of the engineering programs that have had some success. But the transfer population going into a four-year engineering program was more female, African American male, and Hispanic and foreign national, than the population that resides within the engineering program at the four-year school. Now that raises some interesting issues. I’ll address very quickly about how you help that two-year population successfully transfer into the four year.

Now what’s really interesting is how you calculate success. If you’re coming in from a two-year school, you probably have less 30 hours of credit, but there are many different ways of how these credits are assigned or credited and I just want to raise that in terms of NACME’s new NSF grant. I’ve heard some interesting conversations about what’s the appropriate matrix because then those issues will get rewarded based on how well they do. And what we found out is that there were many different ways that this data was collected, often varying even from institution to institution, within the state. So these are the graduation rates we found for two-year transfers, three years after reaching their junior year, and this is only for engineering. And you can see from the charts that the average that was just shy of 60 percent. There are some differences among the communities, but overall we found the populations that went from two-year schools to four-year schools graduated at a higher rate than the native populations in the four-year schools. Does that make sense? And I think that that raises some really interesting issues. I wanted to raise a couple of these issues that I think will be interesting not only to those in the audience, but for the future of NACME and some of our policy issues. One of the things that we found that was very interesting is that there needs to be a clearer understanding of what is a successful pathway. How do you determine that? I was recently at a meeting where I learned that many times students must attend on a full time basis in order to get access to certain scholarships or programs whether they be with that particular institution or not. You might have a student who is transferring but is taking one or two classes and so doesn’t have full time status and is therefore ineligible for certain rewards. So our system of financial aid has certain limits and demanding full time status may not recognize the lives and choices of our students, many of whom have personal obligations including jobs that affect their attendance. And so there’s often this tension around this idea that we all have young, four-year, full time students. The other thing I think that was very interesting in terms of retention. How are we trying to retain our students? We found in particularly that many of the students liked what they did
in terms of curriculum but didn’t have the exposure they needed to career pathways. We also found that many of the two-year students transferred into four year institutions but didn’t have any orientation, didn’t have an opportunity to understand how they could be successful. So I just want to say we are planning in 2014 a workshop on evidence-based strategies for how we can sustainably scale up programs that seem to be doing well for two-year and four-year transferring students. And we would love to engage you as we’re looking at schools that have had these students for more than one cohort, and have had evaluation data demonstrating that they’re having an impact not only recruiting those students, but equally important, retaining them and getting them through graduation.

I just want to end with a couple points. In addition to the orientation sessions that I mentioned there are bridge programs. Some of them have been very important. For example at Louisiana Tech, they actually have a program where the faculty engineering students from four-year schools teach a certain number of courses at the two-year theater schools. At the University of Maryland, actually, and throughout the state, they now offer a statewide two-year electrical engineering degree. So there are different programs that seem to be working and we’re interested in learning about them and how they’re applicable. So I guess, in conclusion, the thing I would add is the one thing I haven’t talked about, and we just issued this report on minority males in STEM last year, is this: if you actually look at where students graduate and the top BS schools in STEM for underrepresented minority males, they are very different for African American men in STEM, of the top ten institutions, two of them are private, the University of Phoenix and Strayer. And we really have to address the issue that we now need to think about how we can create communities that support our young men to not only get the degree but to be ambitious in terms of what they can do so we have a representation in the engineering workforce, not only at the junior levels, but throughout the workforce including the senior and leadership levels. Thank you very much.

There are some differences among the communities, but overall we found the populations that went from two-year schools to four-year schools graduated at a higher rate than the native populations in the four-year schools.

Irving Pressley McPhail, Ed.D.
NACME, Inc.

Now I’d like to bring up Keenan Austin, Senior Advisor for U.S. Representative Frederica Wilson who would like to bring greetings on behalf of Representative Wilson. Another staunch supporter of all the things we believe in this room, a strong supporter of NACME and one of several members of Congress who wrote letters in support of the NACME application to NSF. Please welcome Keenan Austin.

Keenan Austin
Senior Advisor for U.S. Representative Frederica Wilson

Thank you Dr. McPhail for that introduction. This moment reminds me that we should always be ready. I’m standing in the stead of Representative Frederica Wilson from Florida’s 24th congressional district and she is voting right now. Nothing has quite gone as planned for about two weeks now, as you all have seen. But when it comes to creating opportunities Congresswoman Wilson is not someone who only talks the talk, she walks the walk. That is why I’m standing here today. And one of the first friendly faces we met on the other side when we left Miami and got to Washington, D.C. was Marilyn Berry Thompson. Marilyn has been like a god for the congresswoman and has meant so much to us, so thank you on behalf of the congresswoman today. And also thank you to Dr. McPhail, and thank you again for all of your work. You know the congresswoman is a staunch supporter as she mentioned and we will continue to be your voice on the Science, Space and Technology Committee and your voice in Congress. I’ll just read the remarks that the congresswoman has prepared and I’ll get out of here.

STEM education provides people with a vehicle to dream big. From navigating the stars to mapping the oceans, where science and engineering can take us is only limited by our ability to dream. Everyone deserves an opportunity to follow personal dreams in engineering and other cutting edge technical fields. But the underrepresentation of minorities and women in STEM fields remains a serious problem. While minorities represent 29 percent of the country’s population, in 2010 minorities earned just 12.6 percent of engineering’s bachelor’s degrees. This is an inequality issue because STEM fields are where we find good paying jobs that make some of the greatest contributions to society. But it’s also a national, economic competitiveness issue. As our nation grows more diverse our science and engineering workforce must diversify as well. We need people of all cultural backgrounds in trained science and engineering fields to maintain our base of technical talent. NACME is absolutely essential to accomplishing this mission. Your organization for 40 years has been the driving force behind the push for diversity in engineering. I am proud to serve as a member of this Science, Space and Technology Committee, where I am committed to advocating increasing diversity in scientific research and engineering through legislative measures aimed at increasing the participation of HBCUs in aeronautics and space research. This policy work is important, but we can only succeed in showing diverse, nationally competitive, globally competitive workforce through your work. NACME is making this vision a reality. Thank you.
Saundra Johnson Austin  
Senior Vice President for Operations  
NACME, Inc.

I’m going to start by saying good afternoon in the absence of our members of Congress to you our high school, university, and corporate partners, and STEM advocates. It is indeed a pleasure to give this testimony on regional public and private partnerships in STEM education.

It’s only through public partnerships that the NACME organization has been able to achieve success over the past 40 years of awarding scholarships to underrepresented minorities; women and men who are African American, American Indian, and Latino, as well as NACME’s more focused pre-engineering activities for middle and high school students and teachers.

At any rate, I’m supposed to be introducing members of Panel 2. Representing the Exxon Mobil Corporation, Truman Bell, headquarters community relations manager, our board liaison, and longtime friend to NACME. Along with Mr. Bell will be Ms. Beatrice Arvie, Magnet Lead Teacher and Academy of Engineering Director at Scotlandville Magnet High School in Baton Rouge, Louisiana. Our last panelist will be Dr. George Fair, Professor and Dean of Interdisciplinary Studies at the University of Texas at Dallas. My esteemed colleagues will follow me after this presentation.

The NACME business model has been sustained over these past 40 years through the awarding of scholarships that supply the workforce. The model is growing through the expansion of our pre-engineering activities. The model is recommitted to informing the national research debate, and lastly it invests in improving American competitiveness through engineering public policy. This is the familiar slide that many of you have seen the past 24-48 hours. This is our NACME footprint. As you can see from this illustration, there are pre-engineering programs and two scholarship programs for which NACME’s current portfolio exists for students. Since 2007, NACME, the National Academy Foundation, and Project Lead The Way have partnered in a collaborative effort to establish 110 Academies of Engineering, also known as AOEES. AOEES are a national network of career-themed academies designed to raise the awareness of engineering as a field of study that leads to a rewarding career. In this partnership, Project Lead The Way provides a world-renowned project-based curriculum. NACME provides scholarships, engineering awareness materials, and access to a broad range of companies who serve on advisory boards. NAF provides the infrastructure for these academies.

Our second pre-engineering program known as the NACME STEM Urban Initiative is funded by Chevron Corporation. This program engages Project Lead The Way schools in northern California by providing engineering awareness materials, STEM Innovation Grants for teachers in the classroom, and scholarships for graduating high school seniors. NACME looks forward to resuming this activity with the Milwaukee public school district which was our beta site when we first launched the NACME STEM Urban Initiative.

Currently, NACME is in partnership with 51 academic institutions that award scholarships to underrepresented minority students based on financial need. Thirty-one of these institutions received block grant funds to award these scholarships, while the other 20 institutions award in-kind scholarships. In the 2012-13 academic years these 51 institutions awarded 1,250 scholarships to URMs and in the 2010 year 30 percent of URMs who earned a bachelor’s degree in engineering were graduates of those institutions. And lastly, NACME manages a scholarship on behalf of the Alfred P. Sloan Foundation which, to this date has produced 842 students graduating in engineering, natural sciences, and mathematics since 1995. As you can see from this illustration of the NACME footprint, our program has formed natural clusters, regionally, and hence NACME’s development and implementation of the NACME STEM Integration Model. The graphic illustration depicts the points of transition that are critical for a student’s success along the education pathway, beginning at middle school and high school to workforce entry. NACME’s partnerships with high schools provide access to middle school and high school, and in some cases elementary school, students and teachers. We strongly believe that the deeper the engagement with students and teachers the greater the impact on the number of students pursuing engineering degrees.

So what are these objectives that we hope to accomplish with this integration model that we’re all talking about? The goal of the integration model is to facilitate a comprehensive pathway to underrepresented minorities to engineering careers beginning in middle and high school. These objectives that you see in this particular slide are to develop regional partnerships. A regional approach demands the partnership and these partnerships are engaging and effective in meeting the needs of each partner involved, ensuring the investment in the NACME brand.

Many of you know that we are celebrating our 40th anniversary and through this we, for the past 40 years, hold institutions accountable for the production of underrepresented minorities to attract other partners who desire the same results. To evaluate each program, it’s important for us to evaluate the programs that we put in place and that are supported by many of the corporations and foundations. Currently Metis Associates, a third party evaluator, is conducting an evaluation of the integration model. To increase operational efficiency, we all want to do things better, smarter, and work better. Targeting funding opportunities for the integration model will expand the opportunities so more students can be reached.

Thanks to the Northrop Grumman Foundation and AT&T Foundation, NACME will be able to release what you see in front of you as our new set of revitalized marketing and communications materials,
Currently, NACME is in partnership with 51 academic institutions that award scholarships to underrepresented minority students based on financial need.

and this will certainly facilitate the linkage of NACME sponsoring-companies to provide presentations and shadowing experiences for these students and teachers as well. One of the questions that came out of the roll out of the implementation was, what are the current and future benefits of such an opportunity that we’re talking about this afternoon? That is to publicize and provide access to NACME institutions. We found that the many of these schools, these AOE’s, were in the backyards of institutions and people did not have any idea that they existed. So through this regional approach we hope to call attention to those linkages, provide scholarship opportunities, and be sure that the NACME partners also have access to these schools.

Another set of benefits that we see as a factor, and we pride ourselves at NACME, is contributing to valuable research. You’ll hear more of that as the day goes on and certainly tomorrow. But that’s an integral part and it helps us to maintain and provide more programming. And we want these individuals to become a part of that 9,000 or so alumni that we have been able to gather since 1974. There is a role for our corporations. These corporations play a significant role in the model as they provide life-changing experiences for the students and teachers through a commitment to serving on advisory boards and conducting presentations about engineering. The opportunities in this particular field, call for research into what’s going on in particular industries, specifically full-time opportunities and internship experiences. There are three regions that we are certainly looking at, and each of these regions have a specific component and they’re comprised of Academies of Engineering, and again those are a NAF network of career-themed academies. We have the community colleges and these specific community colleges have articulation agreements with the NACME partner institutions. We have the list of those institutions in the first region, the New York/New Jersey region, these schools that you see listed here in record time, in a matter of months went ahead and signed an MOU with NACME, again specifically outlined responsibilities that we’re all holding ourselves accountable for, and you’ll see some of the results that I’ll share with you momentarily about how effective we have been in such a short period of time. Our Vice President for Scholarships and University Relations wanted to make sure that I mention that we are bringing on a new university partner in the state of Texas, and that is Texas A&M University.

California is still in that baby stage where we’re still constructing a STEM Integration Model in the northern California area with all the AOE’s and Project Lead The Way schools. We have a little bit more work to do with that, but certainly we’re learning. We have some specific key object lessons from our experiences in New York, New Jersey and Texas. During the close of the 2012-13 academic year, an executive-on-loan from HP, Lesley Slaton Brown, designed and implemented an advisory board engagement process with HP’s top talent. And the commitments that have been made in terms of what they’re going to be establishing or have established can be appreciated from the next few slides and then I’ll close and invite the other panelists up here. The goal or the objective is to execute a world class advisory board engagement model for the greater AOE success and enhance the learning growth of partners through advisory board development and leadership opportunities and increase the awareness of the return on investment of NACME and NAF key assets. You’ll see the list of schools that HP currently has in New York, New Jersey, and Pennsylvania; Bronx Engineering, City Poly, Manhattan, Rochester, John Dwyer, and Engineering and Science High in Pennsylvania. The second set of the top talent that is serving us in an advisory board capacity in the ten schools in Texas are those AOE’s that you see listed here. And certainly, in some cases there is more than one HP executive that is serving on that advisory group or advisory board.

And then, in California, even though we don’t have as much of an integration model in place there at the present time, we went ahead so that we can get started with some executives-on-loan. Some of the
highlighted we wanted to share about the integration model itself are that we have a total of 29 of those MOUs signed in specific regions in New York, New Jersey, and Texas. Overall, 61 pre-engineering scholarship awards have been awarded to students who are now enrolled at college campuses in the New York, New Jersey, and Texas regions. So that is a great effort on our part to get that done. Some of the real tangible things that we’ve talked about in terms of seniors being able to be exposed on the college campuses before they enroll. City College of New York has been able to offer that, as well as what’s been taking place at Cornell. And for the NACME companies that are serving on these advisory boards we want to give a shout out to you as well, and thank you to HP, AT&T, Marathon Oil, and ExxonMobil.

So at this time I’d like to turn the microphone over to Truman Bell and have him give us a few words of testimony in the absence of our members of Congress and those of you who are also STEM advocates. We’ll have him share a few words of what is going on from a corporate perspective as it relates to our regional model.

Truman Bell
HQ Community Relations Manager
Exxon Mobil Corporation

Thank you, Saundra. It’s a pleasure to be here today. I’ve had the distinct pleasure to be on the panel a few times with the distinguished congresswoman from Texas. If she were here, I would have said, any time you have two Texans that get together and they’re passionate about something, good things are going to happen. I know that she’s here in spirit and I know there are a few other Texans here. The outcome today is going to be very positive. Irv was talking about we’ve done and reminding us that we have a long way to go. I agree with him. When NACME was formed 40 years ago, we were one of those companies. There was a gentleman that had a job kind of like mine, Dick Neblet. He was very active. I don’t remember the whole story, but at some point they made him the Executive Director and he was the first time Executive Director. He later retired and became the first full time director and he stayed around for a while. He introduced me to NACME in about 1988 and had me be on the forum committee in Houston and that was my first involvement with NACME and I’ve supported it ever since. So, a lot has been accomplished in the 40 years at NACME and a lot has been accomplished since I joined in 1988. It’s great to see that progress and we have many miles to go. I’m very pleased Saundra to see the AOE’s, especially the regional collaboratives, working well. I remember when Dr. John Brooks Slaughter, [former] President of NACME, talked about—we’ve got to do things in K-12. We’ve got to get down there and do something. What we’ve done up to now is good.

We’ve been the premier scholarship provider of minority engineering scholarships. I think [Dr. McPhail’s] leadership in the community college arena is really going to pay you dividends down the road. I’m really glad to hear the research that’s coming out of that. I also put a plug in, we need some community college grads that want to use those degrees and come to work. We have a big issue in Houston, Texas. We do not have enough technical skills in ExxonMobil. We’re building a huge facility, natural gas prices and the production of chemicals and things like that are much more expensive today. One example is in Baytown, Texas, which is like a facility in Baton Rouge. It’s going to take 10,000 construction workers to build that. We’re culminating that hopefully in 2016 and there’s going to be a couple of competitors building those things, too. Ten thousand construction workers just for ours; we don’t have the people right to build that. When it’s through there’s going to be 400 technical jobs for that there are primarily process control operators people who have trade skills and community college degrees. It will support 4,000 indirect jobs of the same kind and while we’re lucky to be in the nice economy in the Houston area, we’ve created many thousands of jobs in the last 10 years. I want to see engineers. I’m a recruiter and finding the best and brightest and we need to produce those. We’ve got some great jobs at the community college level and we need to keep those in mind. When you don’t have jobs, send them to Houston, Texas and look me up. I mentioned being with NACME for a long time. I have a number of partners; some of them are in the room. If I don’t mention you today it’s not because I don’t love you. They’re just not going to let me talk all night about this subject.

So we’re going to talk a little bit about strategy. We take a look at our strategy from time to time. ExxonMobil has been in this space for a long time and I can tell you stories back to John D. Rockefeller and Spellman College, some pretty cool stories. In recent times, we’ve really concentrated on STEM. We’ve been using the acronym STEM since the 1990s. I always say when I’m talking about STEM I spell STEM with a big E; engineering is very, very important at ExxonMobil. Most of our hires come right off the campus, we promote from within. Chairman Tillerson was hired in 1976 from the University of Texas, rose all the way to the chairman spot, so when I’m talking to young people I say that similar opportunities are available to you if you want to get with it. With 18,000 engineers and scientists, 16,000 of those being engineers, 2,000 Ph.D.’s, workforce development is something that I think about literally every day. And if we don’t invest today to get young people excited, we’re really quite concerned. I’m not so concerned about the quality of engineers 15 years from now I don’t know what the quality might look like, I’m not concerned about what the quantity is going to be. People argue about that, but I’m more concerned about what the quality of those engineers is going to be. And one thing that leads us to be concerned at ExxonMobil is those international tests that you keep hearing about where are kids are scoring 17th and 27th and all that. If that’s an indicator of how we’re going to compete in the world we’re going to be in a heap of trouble in 10 or 15 years. We have time to do something about it now. We’ve changed our investment strategy around that. In our corporate philanthropy we invest more dollars in fewer programs that really make an impact and NACME is one of those programs. We’re first going to have a continued interest in STEM programs and education strategies that support teacher preparedness and foster student achievements for all students. And when we have a number of programs that we’ve developed that will be good for all students. It is unfortunate for this country that the quality of your education in K-12 is still dependent on where your parents live. My kids were fortunate that their parents lived in an affluent community and they had a great education. Not all kids are that lucky. It
shouldn’t be that way but dadgummit, that’s the way it is until we get it changed. So when we have a program, most of our programs are in very diverse communities. Houston, Texas, according to Steve Kleinburg, a researcher at Rice, enjoys the most diverse population in the United States. If we want to see a diversity program works all we have to do is drop it in Houston Independent School District to see if it will work. If it’ll work there it’s going to work just anywhere I think.

We also learned a long time ago if you invest in teachers you’re going to affect thousands of kids. Irv and I have talked about this before. If we don’t get the teacher thing right it’s not going to make much difference what else we do. Our kids deserve the best teachers and I don’t want to sit here and indict teachers because I’m here because of teachers. We have some great and wonderful teachers in this country. We just don’t have enough of them. We don’t have enough who are proficient to teach science and math. That’s why we invest in those kinds of programs. I feel just like a minister in church, I’m up here and you guys are all pontificating this so I know I’m preaching to the choir so I know we’re going to be ok. We’re also going to support educational programs with proven results that are transforming science and education. I’ve spent the last 15 years or so in the Exxon Mobil Corporation. And I’ve seen every kind of proposal you can imagine and a lot of them were very, very good, but I can’t fund all of those. Everybody says we’ve got a new invention. We want to try some of these, but we don’t have enough time to do that. We’ve seen enough studies; we know what we’re going to do. People in the programs know how to do this. When you come to us, bring us your data. Remember, I work for engineers. If you don’t have data they don’t talk to you anyway. They’ll talk to me because I have a math degree and I can show them the data. But we want to see proven results and I’ll give you some examples of that.

The third one, and this is fairly new to us. This is kind of strange new territory to corporations. We’re venturing out there and we’re serious about it. We want to advocate for the improvement of the U.S. education system and align resources to support the common core state standards and in the next generations the science standards. We could get a real political debate on Capitol Hill this afternoon if I just went out and said that. But as a corporation we strongly mean that. If we don’t set these are our students and it’s up to us to talk these kids into being teachers. And they went out to recruit every Natural Science major at the University of Texas and those are a pretty premier group of students. That’s a research institution, whether you’re a UT football fan or not. They have very good kids in the College of Natural Sciences, but they weren’t producing a lot of teachers. There was a Dean there named Maryann Rankin. She’s now at Maryland, College Park, as Provost, and a big visionary who believes that we can make this happen and a physics professor named Michael Marter. Ten years later they had put together a program where they were certifying teachers out of the College of Natural Sciences with the state of Texas endorsement. They were using a master teacher approach and in four years at a research institution kids were getting a degree in math or geology or chemistry or physics. They had to have a degree and they were certified and ready to teach. They also got exposure to the classroom on day one. And they all throughout their experience they knew what they were getting into so when they went into the classroom they tended to stay and had a good experience. Five years later 92 percent of those kids who graduated went into teaching and five years later 82 percent are still in the classroom. That’s much higher than the 62 percent on the national average. I know what a struggle it is to keep good teachers in the classroom, because my daughter just put in her fifth year in the classroom and now she’s going to pharmacy school. It’s really hard to sustain very good teachers in the classroom. The pay is just not there, so you have to be driven by something more than money, a passion to help the kids. UTeach programs found that using our model, with NMSI we helped to replicate that. You can see here that we now have more than 6,000 students enrolled in these programs at 34 universities in the United States. Through some new funding we will soon have more than 40 universities in the system. This fall semester we’re heading toward 50. With 50, we’ll produce on an average of 50 or 60 mentored math degree teachers every year. Now, I have a math degree, but just because you have a math degree doesn’t mean you can be a good teacher. In fact, many of us with math degrees shouldn’t

We have some great and wonderful teachers in this country. We just don’t have enough of them. We don’t have enough who are proficient to teach science and math. That’s why we invest in those kinds of programs.
When I leave here I’m going to push a button and the top is going to go down. I’m going to a football game in Dallas, Texas and I’m going to sit with the college president. I’m going to sit down and I’m not going to sweat with the rest of the people in the stands. And the reason I can do this is because I worked hard. I got a STEM degree. Now, do you want to get a STEM degree? They were ready to go. I will use those kinds of hooks. You can produce very bright people in math and science, but you have to inspire young people to become engineers and scientists and I love doing this, giving them role models. I think Leslie from the National Engineering Foundation is going to be here. I love National Engineering Week. We introduce girls to Engineering Day. We do that at 14 locations in the United States because young girls just don’t get exposure to engineers. We make sure they get a chance to be with engineers. I’m sorry that I’m pontificating here. We’re going to produce teachers. We have a lot of teachers who still need development or help and need some good hands-on math and science. And I love elementary teachers, don’t get me wrong, but elementary teachers need to learn a lot more about math and science, though of course I’m here because of elementary teachers. We decided to invest in the academy. Phil Mickelson and Amy Mickelson are advocates for us. You may have seen their ads. They’ve got kids and they understand how important math and science are. And it’s a little unusual for an oil company to go all the way back to 3rd, 4th, and 5th grade and worry about what the teachers are doing, but that’s the time that kids minds are really changing. When they really learn mathematical principles they’re on that road to algebra, they’re getting excited about science. It’s really critical; they probably need the best teachers in the 3rd, 4th, and 5th grade. But an elementary teacher has to teach everything. They’ve got to teach a little history, science, they have to do PE in the seventh period, and they still have to teach math and science and many of them have not been honed well in math and science. The academy is a reality for them, we teach 600 a year at three academies. It costs us a little money, but we treat teacher’s first class, we’ve now trained over 4,000. Those teachers are very inspired to go back and I dare you to find one those 4,000 who will tell you it wasn’t a wonderful experience for them. We really believe in the teacher. I was very fortunate to work with the late Dr. Sally K. Ride the first woman astronaut, a very tenacious lady. You couldn’t talk her into anything she didn’t want to get into and we worked together for about a year before we put together the Sally Ride Science Academy. It’s based on careers. There’s significant research that shows that we lose young kids between the 4th and 8th grades, especially young girls who were once really inspired about math and science. Something happens in those four years. And NACME understands that if you don’t get kids by the 8th grade you’re probably not going to get them, you’re going to get a few, but that’s going to be an anomaly. Most of the kids who aren’t inspired, aren’t going to take those courses in high school AP and aren’t going to become engineers. So we do a lot of investment at the upper elementary and the middle school level. We love astronauts at ExxonMobil. Dr. Bernard Harris, have any of you heard him speak? If you ever get a chance, his claim to fame is being the first African American to walk in space. How many of you ever watched Star Trek? Remember Star Trek? Dr. Harris grew up as a kid in Houston, Texas, watched Star Trek and said “I want to do that. I want to be a space doctor.” That was his dream and he eventually did that. He got a science degree. He graduated with a science degree from Texas Tech College of Medicine. He became a space doctor and went up twice. Now he’s a worldwide entrepreneur. But he remembers where he came from and pays back. He has developed a very good summer science camp, two weeks residential, for inner city kids who’ve got good grades, but need that extra push. We have 20 of these universities that range from the University...
There’s significant research that shows that we lose young kids between the 4th and 8th grades, especially young girls who were once really inspired about math and science. Something happens in those four years.

you have to be a CEO or report to a CEO. There are only four individuals in the entire Exxon Mobil Corporation that are eligible to be on NACME’s board. And we have one member on the board and we’ve always had one. Now, there’s also tough love that comes with that. They know how to manage billions of dollars of money. So, that they scrub things pretty good. But that keeps this organization very stable. It gives me, as an investor, a good feeling that the money and the processes are really being watched. Why do we invest in precollege education, well, for workforce development? Those 18,000 in engineers and science don’t just happen. If I want to take a leadership role and to make sure that our workforce is going to look like it’s up to me to get active to find out what’s causing issues in there—why we don’t have underrepresented minorities, why we don’t have women, and that kind of search lead my predecessors many years ago to invest in these kinds of programs. We also for corporate citizenship reasons, need to prepare kids for the 21st century. This is a complicated world we live in. When I’m talking to kids, I’m talking about STEM as really literacy. If you aren’t proficient in math and science somebody’s going to take advantage of you in the future because they’re going to know it and they’re going to know how to do these things and you’re not. If you number one and if we don’t do better, they will be. We want to see a STEM workforce that looks like the population of the United States. It’s not there and that’s why the word underrepresentation exists. As long as it does, we’re going to need programs like NACME, and to produce a science-savvy citizenry. I have to say that comes slow. I know there’s a lady here from Project Kaleidoscope, a lady who ran that program for many years named Jeannie Nieman, and I adopted some of her views and practices her about 15 years ago. This is science literacy, what I just mentioned a moment ago. We’re going to build the workforce with engineers and science and we want everyone to be science savvy. NACME has programs that start at the middle school age that’s one thing we like about them. They believe in raising the bar high for students. They engage teachers and administrators. We know you have to do that. They also engage parents, and they also have a great financial system. This model where you’re going through grade school to high school, you are now addressing the community college and the universities and the kid is not only inspired to go to college but there is financial support to do that. That’s where a lot of my investment is going. I’m really pleased to see the partnership with National Academy Foundation, Project Lead The Way, and NACME. We can’t all be experts in everything, so bringing three experts together, this is where 1+1+1=7. I’ve got a math degree and I can say that with a straight face and mean it. We’re very pleased to be partners with NACME. I can say all kinds of rah, rah things, but I think I’ll turn it over to other colleagues that are in communities that I care a lot about. Thank you.

Beatrice Arvie
Magnet Lead Teacher
Academy of Engineering Director
Scotlandville Magnet High School

Good afternoon. Our first task was to determine and to let you know why we decided to support an Academy of Engineering and why we choose to become a part of one. First of all, there’s a need because so many engineers are getting to retirement age and they aren’t going to have any one to replace them. So with that in mind, we decided that we needed to be a part of this. Then the opportunity is there. There’s an opportunity to help provide female engineers and I think we’re pretty good at that. You’ll see the data as we go through. And then the timing, the timing was right when industry came to us and said we will support engineering in your school. We already did engineering, but we were not a part of the Academy of Engineering and I believe Truman saw somebody years back and said, hey, go talk to those people in Baton Rouge at Scotlandville High School and that’s how we really became a part of the Academy of Engineering.

The impact that becoming a part of this has had on us and on our community, is that it has increased the number of students who are enrolling in four-year institutions, and it’s increased the number of paid internships. For those of you who know a little about the National Academy Foundation, one of the requirements is that we must provide paid internships for juniors after they finish their junior year in high school so we’ve been able to increase that number of paid internships. We’ve increased the number of job shadowing opportunities for our students. We have increased community awareness, so when you talk about engineering, they say, “Oh, that Scotlandville, you can go there and get in an engineering program.” We have the only engineering program in our district. College recruitment efforts increased...
because our students are a part of the Project Lead The Way curriculum; they are prepared when they walk out the door, so colleges now realize that and they’re coming for our students. We have NACME to thank for that because when they have representatives on their board who have companies in our geographical location, they will tell them, or tell me, we’re going to send this person to talk with you and that helps to build our board thereby helping to increase job opportunities, while also increasing the number of internships that we are able to provide. We are bridging the transition from high school to college because there are two major universities in our area and our students visit those universities. We take all of them there to see what’s there, to walk the campus so that they’re available; they know they’re competent when they get there then they know where they want to go.

Increased community outreach opportunities: our students are invited to speak at meetings. There’s a GBRIA conference for all the members of the industrial industry in the Louisiana area on the river. We have students who speak at that. We haven’t gotten to the Chamber of Commerce yet, maybe we can get there, somebody will help us get to that level, but they also speak at the ASCE annual meeting and I tell you when they finish everyone is concerned and more interested. The partnership: partnerships are really, really important, and the one that we’ve developed with NACME has done so much for our school and for our Academy of Engineering. It helped to brand the Academy. How did it do that? It gave every student a backpack that made them feel, hey, I’m really a part of something, and that was important. It came at a crucial time for the transition from high school to college.

Dr. McPhail, I can’t say enough about him and what he does. We didn’t have money. When I said Dr. McPhail I need you to come and speak at our fundraising breakfast audience and I can pay you. And he said, “Well, ok, just for you.” And, he did. But what his stipulation was I want some good food. So, of course, we have the best food in the world in Louisiana, the tastiest Cajun food, spicy and just really good and I took him around to several places to eat and he was happy.

The awarding of STEM teacher grants: we needed to recruit females in engineering and, of course, in the high schools where we don’t always have funding. They don’t give you money to do what you need to do. So, I wrote for this grant for two-years, and we ended up with more female students in our program as a result of inviting them and providing activities for them with girls who were already there and with our female teachers. The funding that we got, $7,000 the first year, came through a board and we were able to purchase Project Lead The Way materials. We want to help you support your program through Project Lead The Way. The second year we got $5,000. Each time the curriculum changes a little bit and they say you need to upgrade and we do that. The funding is there for it. Who does that? Who does that? The National Action Council for Minorities in Engineering—NACME. That’s what you call a partner. They are our partner.

Concerning recruitment and retention you can just look at the slide and see where our kids are from our pilot year. Those kids are sophomores, they are still in college. The college freshman who just graduated in the first graduating class from the Academy of Engineering. The seniors now are going to 2014, 2015, and 2016. That’s our enrollment. The demographics of our pilot project that we did during our year of planning—we had 24 females and 15 males. The internships we did in 2012. We were not required to do those internships because we were in a pilot year. We tried it anyway, and this is what we ended up with. It worked for us. We had 33 interns. Those students who graduated 2012, these are the colleges that they attended. These are the majors. And if you notice, the majors are all STEM majors except for two. The demographics for the class of 2013 consisted of 22 females. We’re talking girls in engineering. We’re talking minorities and underrepresented students. The internship program, it grew. We had 42 students who had paid internships in these companies, including juniors in high school before they go to their senior year. These are the colleges that the students are presently attending. When we talk about that pipeline, being at that backdoor of Southern University. The Chancellor attended the school along with all the deans. I told them what I needed from them and this is where our students went. This is what they are presently majoring in. You’ll see that mechanical engineering is way up there. So, Truman, ours will be there for you and of course, Marathon and everyone else. We were part of the second cohort of the Academy of Engineering.

Student testimonies . . .

The proof is in the pudding and what we produce at Scotlandville High School as a result of the partnerships we had with NACME, Project Lead The Way, and NAF. The progress to date, what has happened up to now, the collaboration between the key stakeholders, we can’t talk about that enough. We can’t say how much of a difference it is making and will continue to make; the increased representation of African American, American Indian and Latinos in STEM careers; the powerful partnership between our feeder middle schools. We have a feeder middle school less than three blocks away and we’re working with them hand in hand to be sure that what we have in the 8th grade is what we’ll continue in 9th grade. The Academy of Engineering just being a part of that is powerful. The regional university partners and of course the local STEM corporate enterprises. We’re very grateful for that and we thank you.

Dr. George Fair Professor and Dean University of Texas at Dallas

It’s a pleasure to be here with you to tell you a little about the University of Texas at Dallas, we are a new partner. As a new partner university, I will address several questions just to give you a sense of what we do as a partner university and to tell you about how we have conceived what we’re doing. Some of the topics I will cover and questions that I will give you an answer for include: The overall AOE opportunity; AOE experience at UT Dallas; How has UT Dallas embraced this model;
College preparedness of AOE graduates: The academic rigor of AOE graduating seniors; The academic rigor that AOE graduates face at Dallas; Successes and challenges of the engineering program at UT Dallas; and some best practices. As we begin this, to do this I want to first give you a little bit of a context from which I speak. The University of Texas at Dallas is one of the nine comprehensive universities in the University of Texas system. Of course, all of you know of the University of Texas at Austin, with its long history and its football program. In contrast UT Dallas does not have a football team and does not have any plans to develop one. UT Dallas likes to think of itself as a very selective, competitive academic environment focused on becoming a Tier One university. As you know Texas is a rapidly growing state with only three Tier One universities: the University of Texas at Austin, Texas A&M, and Rice University. In the next 10 or more years that will be the realized goal of UT Dallas. We have a president, David Daniel, who is an engineer. He has articulated Tier One status as a goal because of the growing metroplex, now as you may know, the fourth largest metropolitan area in the country behind New York, Los Angeles, and Chicago.

We are a growing area and we continue to grow and UT Dallas will continue to keep pace with this growth. UT Dallas began as a university in 1975 and I joined the institution at that time from the University of Pittsburgh. I’ve been dean of one of the seven schools for the last 20 years with the responsibility of interdisciplinary programming and other university-wide programs. One of these programs is named the Academic Bridge Program (ABP) and I’m going to speak about that shortly. So in summary, the University of Texas at Dallas serves the metroplex and the state of Texas as a global leader and an innovative high quality science engineering business education and research. We think of UT Dallas as an institution in the heart of north Texas offering 130 academic programs across seven schools and providing some of the state’s most lauded science programs—and that’s our goal—to develop to be essentially one of the Tier One and growing universities. We’ve grown each year over the 38 years since we started back in 1975. We grew this year, and grew to over 21,000 students at about a seven percent level, and we expect to continue to grow and UT Dallas will continue to keep pace with this growth. UT Dallas began as a university in 1975 and I joined the institution at that time from the University of Pittsburgh. I’ve been dean of one of the seven schools for the last 20 years with the responsibility of interdisciplinary programming and other university-wide programs. One of these programs is named the Academic Bridge Program (ABP) and I’m going to speak about that shortly. So in summary, the University of Texas at Dallas serves the to think about growing until we get to 30 or 35,000 students. So, we’re on the path to growing and we think that we will continue to have students mainly from across Texas but from all parts of the United States. Engineering is essential to the mission of UT Dallas, which is committed to be a global leader in the engineering field. I’ll talk a little about our engineering field. I serve as I said as one of the seven deans and we have a dean of engineering, with which I work closely. The Johnson School of Engineering and Computer Science is strategically located next to the telecom corridor which is where UT Dallas is, in Richardson, just north of Dallas, a city that’s home to more than 600 high tech companies and is growing each year. This includes the hiring of additional faculty and the expansion of programs. We’ve started new programs in biomedical engineering, mechanical engineering, materials science, analog electronics, cyber security, and control systems. The areas in which we offer degrees are biomedical engineering, computer science, software engineering, mechanical engineering, telecommunications engineering, computer engineering, electrical engineering, software science, and systems engineering and...
We do that as a way of instilling a real sense of building cohort alliances and the students then are housed on campus in June and July and receive a weekly stipend for food. They receive mandatory tutoring and meet weekly to discuss their experiences and concerns. This allows staff to follow up on any issues that may arise.

The GPA of the 2013 summer freshman session was 3.2. Students were assigned upper class peers who act as mentors and lived among the students as residential advisors. So we have a program that’s been established now. We have juniors and seniors in that program that really mentor the freshman and live with them and give them a sense that this is a successful program that they can be successful in. In addition to their studies, new students participate in campus activities as well as field trips and community service outings. The summer program has proven to be important to the students’ success, helping them to develop good study habits, to acclimate to college life, to seek tutoring when needed, and develop relationships with the staff. This group experience also leads to friendships with other academic bridge students who go on to provide encouragement throughout their college years. The bridge program has its own facilities or offices in one of the buildings. The students receive ongoing support throughout their college years including support and mentoring as well as peer advising by senior ABP students. Staff reviews grades and advises students to keep them on the path to earning a degree. Students often face financial struggles and family issues which can create hardships in continuing their education and we on the staff try to assist students in finding financial aid and job when those kinds of situations occur. We also are very selective in doing this, we recruit students primarily from the Dallas Independent School District and we do that in addition to the normal recruitment process. We have a face-to-face interview with each of the students and we really try to find those students that have the commitment and the kind of interests and attitude-individuals who say they want to be successful at UT Dallas.

An academic bridge study center gives students access to a place to study, to receive tutoring and touch base with fellow students and staff. Labs provide easy access for students who can’t afford one of their own and give students access to career development, arranging guidance for students related to their career plans.

Demographic breakdown of 2013 academic freshmen class: 70 percent of the students came from Dallas Independent School District, the rest are from adjacent districts. 66 percent were Latino, 14 percent were African American, 14 percent Asian and six percent Caucasian. Sixty-eight percent of students were male and 38 percent female. Success is measured each year by retention rates, GPA, and graduation rates.

We find opportunities for students to be successful by looking at the grade point averages and internship opportunities for them. Approximately 90 percent of the students return after their freshman year, and we have about 45 percent majoring in engineering and/or science or business.

Attendance, tests, and GPA are tracked on a semester basis, at mid-term and the end of each semester. Upper class GPA’s are reviewed at the end of each year and as we go through and find opportunities for students to be successful by looking at the grade point averages and internship opportunities for them. Approximately 90 percent of the students return after their freshman year, and we have about 45 percent majoring in engineering and/or science or business. We’re graduating on a five-year basis, approximately 78 percent of students which equals a university rate and is higher that state or national averages. Additionally, Academic Bridge students are active participants in the program and work during the program and throughout the year. Graduates of our program are employed by many local industries and, as I said, we have many that have gone on to engineering jobs. I want to give you a little bit of a sense—we have eight students that are now graduates of the AOEs in the Dallas Independent School District and we have eight high schools in the DISD. We’ve had five graduates from the Emmett J. Conrad High School and they’re majoring in electrical engineering three are majoring in computer engineering. We have graduates from North Dallas High School, one who is majoring in biomedical engineering, another in computer engineering, and two that are majoring in electrical engineering. And so they have cumulative hours, the largest is 93 hours moving into senior year, 77 hours, 73 hours, 53 hours, 30 hours, 34 hours, and two began this year as freshman and their GPA range from 3.31 down to 2.2. So what we are attempting to do is to work with the AOEs to bring students into our program that we feel can be successful and we do that by really spending a good deal of time and having our advanced students work with them.

I want to give you a few of the characteristics as we talk about them. The average age is between 20 and 21. As we look at them across the four years at UT Dallas, graduating in 4.5 to 5 years from the program. The largest majority are male and Latino, although we have a smaller group of females and African American students as well. In high school at the AOEs, many of them have taken calculus, AP calculus, and either AB or BC calculus. When they come to UT Dallas we find that it’s often helpful for them to begin that summer program where we have that first math course for them to take that calculus class again because we find—I’ve had one of the students say that the AP calculus that he took in high school helped him to pass the test, and getting a good score on the AP test, which we know is probably accurate as far as AP calculus is concerned. But as he described it, this is how you get the answer but he said the calculus at UT Dallas is why you get the answer. So we really encourage students that have taken it in high school to take that first course in math in the summer over again, just so they can be really ready for the big person’s calculus at the university. We find that that’s a key element to having them be successful in that first math course and hold their own as they go through the calculus.

National Action Council for Minorities in Engineering, Inc. (NACME) 27
sequence and the other math courses that they need to take.

The APB program has provided a safety net for students’ first year, a place to study, a place to go and a place to meet friends with other students; a great place to talk to other students who are committed to school. As we have said all of our students are not residential students. Since we are adjacent to the city of Dallas, many students commute to UT Dallas and obviously commuting is a lot different than living on campus. We have been able this year, in this freshman class, through some extra funding we’ve attained, to have all 35 of the Academic Bridge students on campus, and that’s made a major difference for many of the students. But continuously, over this year the Academic Bridge Program has provided opportunities for the students to work and be successful so that we find a way for them to be successful on campus and provide the extra incentives and support for them to be successful at UT Dallas.

The other thing that we do is that during junior year we try to provide some internships, and we’ve tried to provide them at local corporations and that’s been a successful effort. The one thing that I’d like to say about our best practices is the way that we have attracted many of the successful students at UT Dallas for the last five years; we have conducted a summer program for high school sophomores or juniors, a two-week program at UT Dallas. We bring them to UT Dallas and focus on what it means to come and live on a university campus and we provide two weeks of work for them so they get a sense of what studying on the UT Dallas campus is like. During those two weeks we focus on SAT preparation and the application process for admission and financial aid. We offer some instruction on essay writing for admission and scholarships. We have them visit many of the UT Dallas programs. We have a robotics program where they use Lego Mindstorms to build robots and do some other robotic activities. These students find that it can be enlightening to live on campus for two weeks with people you don’t know.

Students typically leave feeling that this is something they want to do for a much longer period of time. We also bring in campus speakers and do corporate visits. For instance, we have visited the CISCO headquarters in Dallas several times. By bringing students to UT Dallas after their sophomore or junior years in high school, we help them develop a sense of what it means to be a college student. That’s the kind of experience that I think is important if we really want students to be successful. They can spend time with persons that think the same as they think and it is a great opportunity for our advanced students. They see students that they have known and who are successful and that sends the message that they can be successful as well. Thank you for the opportunity talk about this.
On October 2nd, NACME convened a special STEM session to examine and recommend federal policy for advancing minority participation in STEM education and careers. The joint Congressional STEM Session—originally scheduled to take place on Capitol Hill—was held as a special addition to the 2013 NACME National Symposium. Participants and attendees of the special STEM session, as well as those who attended the Symposium, had the opportunity to submit written testimony, which will be sent to those Members of Congress who originally convened this session and are leading the effort to advance minority participation in STEM.

Section Contents

30 Beatrice J. Arvie  
Academy of Engineering Director  
Scotlandville Magnet High School

33 Legand L. Burge, Jr., Ph.D.  
Dean  
College of Engineering  
Tuskegee University

38 Eileen M. Campbell  
Vice President, Public Policy  
Marathon Oil Corporation

41 Stacey DelVecchio  
President  
Society of Women Engineers (SWE)

43 Richard Kazis  
Senior Vice President  
Jobs for the Future and  
Carol A. Lincoln  
Senior Vice President  
Achieving The Dream, Inc.

48 Janet Bandows Koster  
Executive Director and CEO  
Association for Women in Science

51 Madiha Kotb  
President  
ASME

52 Rebecca B. Ramos  
Program Coordinator  
NACME and FGLSAMP Scholarships  
Center for Diversity in Engineering and Computing and Office of Student Access and Success  
Florida International University

55 Brittany Wilkins  
Founder & President  
SIE LLC

National Action Council for Minorities in Engineering, Inc. (NACME)  29
Written Testimonies on the NACME Special STEM Session

Beatrice J. Arvie
Academy of Engineering Director
Scotlandville Magnet High School

Academy location
Located in southwest Louisiana in the industrial corridor near Louisiana State University and Southern University

Highlights

Academy support

• National—partnership support from NACME and National Academy Foundation through grants, media, scholarships, grant funding opportunities, local advisory council membership support, and financial support.
• District—East Baton Rouge Parish School District supports professional development and materials and equipment for classroom and program sustainability.
• Community—advisory council membership provides compensated internships for rising high school seniors in engineering firms throughout the community as well as support for in school activities designed to develop college and career readiness in program students. They also provide opportunities for students to speak at public engagements to other community and industrial partners.
• Administrative—administrators support activities for student growth during the school day and Saturday activities necessary to prepare students for college and career readiness.
• Parental—parents attend and support institutes designed to provide guidance in preparing their children for internships.
• Universities—provide field opportunities for students to tour engineering programs, shadow engineering students, investigate school admissions, meet the professors and deans of departments, and get a general field for the college setting.
• Sustainability and Growth—documentation is provided to show growth and sustainability for the STEM model. Graphs and charts included.

Summary

NACME demonstrates best practices for partnering with institutions serving underrepresented minorities and female students to shape an American STEM Workforce Where Diversity Drives Innovation and Global Competitiveness.

Testimony in support of Advancing URMs in STEM Education and Careers

Scotlandville Magnet High School is located in the heart of the Industrial corridor in Baton Rouge Louisiana and is supported by local industry, academia, and the business community. We were contacted by National Academy Foundation (NAF) in 2008 as a result of ExxonMobil’s board membership with National Action Council for Minorities in Engineering (NACME) and asked to consider becoming part of the second cohort of Academies of Engineering to help provide a pipeline of students for future employment as current employees near retirement age. We thought it extremely important to continue development and support of the pipeline for providing engineers globally by supporting females and underrepresented minorities and agreed to join the cohort.

As Academy of Engineering Director at Scotlandville Magnet High School, my role in STEM is to recruit, retain, and graduate students in STEM disciplines and to insure that they are prepared for the next level to enroll in STEM program across the nation. Following the NAF model, PLTW curriculum, and NACME support, we have been able to reach beyond the goals that have been set for determining success. Much credit is given to my principal, Mr. Howard Davis, who has trusted my judgment by allowing me to run the Academy of Engineering program at Scotlandville Magnet High School with fidelity. His support has been unending and his effort to keep the students traveling in cohorts has made my job so much easier. The High School for Engineering Professions Advisory Council for the Academy of Engineering has been phenomenal through their fundraising efforts to provide Princeton Review ACT Prep for engineering students, in-kind hours from engineers guiding students through the design and construction of a vehicle for the NASA Great Moonbuggy Race, scholarships, serving as classroom speakers, and providing opportunities for students to speak at major industrial, petrochemical, and professional engineering organization events. The East Baton Rouge Parish School District has been supportive in continuing to hire and train the best teachers for the program. The parents support the Academy of Engineering at Scotlandville Magnet High School by participating in workshops to improve the relationship between the teachers and their children enrolled in the program. They also travel with students on field trips and provide support for engineering events and tutoring. The students are very proud of their program and as they travel through their cohort building relationships with their teachers and their peers, they understand and appreciate the many opportunities to which others may not be exposed.

We have gathered data that proves that our students are being prepared for the global workforce. For the past five years, Scotlandville Magnet High School has been in partnership with NACME, NAF, and PLTW to prepare students to compete in college engineering programs nationally. Through NACME teacher grants for recruiting underrepresented students into
STEM, we have been able to develop our program to show the data in Table 1. The decision to focus on STEM has impacted our community through the development of partnerships with engineering firms to provide internships, job shadow opportunities, participation in Career Day, Speed Interviews, Engineering Expo, classroom engagement with students, field trips, tutoring in math and ACT preparation, college tours, and an overall community awareness about where students are best prepared to enter engineering colleges and complete the curriculum. The community is further impacted because many of the local and regional universities are now competing for student enrollment in their STEM programs. Southern University Baton Rouge reached out to our students, brought them to the university where they were greeted by Chancellor James Llorens and the deans of each department, waived the application fee, provided scholarships to qualifying students, allowed them to shadow students in engineering, provided campus tours, and treated them to lunch at the famous Mayberry Dining Hall. As a result of this outreach, university students volunteered to tutor seniors to help increase their ACT scores to insure acceptance and more students enrolled in engineering disciplines in the fall of 2013 than ever before. This is verified in Table 5.

Through NACME grants, we have been able to provide additional classroom materials and resources to support the curriculum being taught in our AOE. Without NACME funding and support for STEM, our students would surely not have been exposed to the engineering awareness materials, NACME board representation on our local advisory council, scholarships to aid our students with college tuition, and teacher grants to help with recruiting, retaining, and graduating students to continue growing the STEM diversity pipeline.

NACME has participated in every available opportunity to increase the STEM pipeline for underrepresented students.

- Reached out to our pilot group of engineering students and provided each Academy of Engineering student with a NACME backpack to help brand the academy. Who does that?

- Provided an opportunity for two of our tenth grade underrepresented students to speak at their National Symposium in St. Paul two years ago; an unforgettable experience for all. Who does that?

- Successfully encouraged their national board members to reach out to our local Academy of Engineering Advisory Council by joining forces to provide unlimited human resources so that students could have mentors who look like them. Who does that?

- Provided $2500 scholarships for qualifying graduates of the first Academy of Engineering graduating class at Scotlandville Magnet High School. Who does that?

- Attended our Advisory Council fundraising breakfast to deliver the message of “The American Dilemma” to an engineering audience of more than 200 members while encouraging them to provide opportunities for job shadow and internships for high school juniors and seniors. The number of internships increased from two in 2011, to 33 in 2012 (Figure 1) and to 42 in 2013 (Figure 2). Who does that?

- Provided STEM teacher grants to aid efforts in recruiting, retaining, and graduating female students. We have retained and graduated female engineering students. Class of 2012—(Figure 3), Class of 2013—(Figure 6). Who does that?

- Provided a $7,000 grant in 2012 and a $5,000 grant in 2013 to purchase Project Lead The Way materials to support the curriculum for hands on activities in Principles of Engineering and Introduction to Engineering Design. Who does that?

**National Action Council for Minorities in Engineering, Inc. (NACME)**

The progress-to-date of the Academy of Engineering at Scotlandville High School sets the stage for the eventual development of the NACME STEM Integration Model (NSIM) in Southwestern Louisiana. The genius of the NSIM is the power of collaboration between key stakeholders in the regional effort to increase the representation of African American, American Indian, and Latino young women and men in engineering education and careers. We have successfully forged powerful partnerships between our feeder middle schools, the AOE, our regional university partners, and local STEM corporate enterprises. We look forward to developing the NSIM as a best practice solution to the “New” American Dilemma in Southwestern Louisiana.

In summary, a partnership is synonymous to a marriage where the husband insures that spousal care is a priority. In the case of NACME and Scotlandville Magnet High School Academy of Engineering, our sustainability is a priority for NACME. We do not have to ask NACME for support, our partner knows the needs and our AOE receives provisions as is customary in a marriage. We support in totality the partnership and know that NACME has the best interest of all of its partner schools at the helm of the decisions to support underrepresented students across the nation. NACME has a proven record for excellent stewardship over funding to support underrepresented minorities in the STEM fields.

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**Table 1—Student Completion Status**

<table>
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<th>Graduation Year</th>
<th>Graduated Males</th>
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<td>23</td>
<td>College Sophomores</td>
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<td>2013</td>
<td>38</td>
<td>20</td>
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<tr>
<td>2014</td>
<td>39</td>
<td>18</td>
<td>High School Seniors</td>
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<tr>
<td>2015</td>
<td>42</td>
<td>36</td>
<td>High School Juniors</td>
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<tr>
<td>2016</td>
<td>57</td>
<td>29</td>
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<td>2017</td>
<td>52</td>
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<td>High School Freshmen</td>
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Figure 1. Interns

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Figure 2. Internships 2012

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Figure 3. Colleges Attended by 2012 Graduates

<table>
<thead>
<tr>
<th>Northwestern State University (NSULA)</th>
<th>Louisiana Tech University (LATech)</th>
<th>Xavier University (XULA)</th>
<th>Southeastern Louisiana University (SELSU)</th>
<th>Louisiana State University (LSU)</th>
<th>Grambling State University (GSU)</th>
<th>University of Louisiana at Lafayette (ULL)</th>
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Figure 4. Graduates’ Majors in College 2012

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Figure 5. Demographics

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<th>Graduating Class of 2013</th>
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<td>Males 37.63%</td>
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<tr>
<td>Females 22.37%</td>
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Figure 6. Colleges Attended by 2013 Graduates

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<th>Xavier University (XULA)</th>
<th>Vanderbilt</th>
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<th>Tuskegee</th>
<th>Texas</th>
<th>Southern University (SU)</th>
<th>Southeastern Louisiana University (SELSU)</th>
<th>Military</th>
<th>Loyola</th>
<th>Louisiana Tech University (LATech)</th>
<th>Louisiana State University</th>
<th>Louisiana College</th>
<th>BRCC</th>
<th>Auburn</th>
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Figure 7. Graduates’ Majors in College 2013

<table>
<thead>
<tr>
<th>Unknown</th>
<th>Welding</th>
<th>Training</th>
<th>Recording Engineering</th>
<th>Psychology</th>
<th>Pre-Med</th>
<th>Nursing</th>
<th>Mechanical Engineering</th>
<th>Environmental Science</th>
<th>Environmental Engineering</th>
<th>Electrical Engineering</th>
<th>Computer Science</th>
<th>Computer Engineering</th>
<th>Civil Engineering</th>
<th>Chemical Engineering</th>
<th>Business</th>
<th>Biomedical Engineering</th>
<th>Biology</th>
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Second, improving K-12 preparation for college and technical training would enhance talent development for industry, government and academic preparation for graduate school. Most important, a full and robust development of research in the military, industrial, scientific, and academic complex spurs innovation and provides a transformation necessary for manufacturing, ingenuity, and creativity. This multifaceted strategy will provide a pathway for effective programming with public support and long-term benefits. The nation has a cadre of bright faculty, the commitment of selfless teachers, and an industrial base poised to support the workforce. The following recommendations are to advance URMs in STEM education and careers that include:

1. Encouraging, inspiring, and informing elementary and secondary school students and their parents about the opportunities of a first-rate education and, encouraging all students to achieve goals of success in learning;
2. Demanding the country’s educational systems, from pre-K to graduate school, provide all students with a quality educational experience regardless of race, gender, place of birth, language, physical ability or economic class and broadband access;
3. Demanding that every classroom have a qualified teacher (in the discipline); that Colleges and Universities produce such teachers and that support is given to our public schools with compensation for teachers commensurate with our expectations for their performance;
4. Ensuring that deserving students with financial need have the resources necessary to complete their educations without fear of having to dropout or give up because of a lack of money.
5. Realizing that this effort to advance URMs in STEM education and careers is a marathon, not a sprint, and that the investment short- and long-term will mean a huge difference in the long-term quality of life for our nation; and, that the long-term is a spectrum from pre-K to graduate school with success as a measure of entry into the competitive workforce.

Introduction
I come to you today as the Dean of the College of Engineering and Professor of Electrical Engineering at Tuskegee University since 1999, after a professional career as a military officer of the United States Air Force for more than 30 thirty years, to address why the country should invest in advancing underrepresented minorities (URMs) in STEM education and careers. I have been involved, in one sense or another, with efforts toward ensuring the value, development, and insertion of qualified and performance-ready talent that is recognized in African Americans, Latinos, and American Indians in science and technology, particularly in the field of engineering, and other STEM areas. Indeed, through the armed services there is progress. I am fully aware that it has not been enough progress due to the necessity of national defense utilizing American citizenry, and that there are barriers that continue to rise to make further progress even more difficult to attain. I received my B.S., M.S., and Ph.D., in electrical engineering from Oklahoma State University (OSU). I held internships throughout with Oklahoma Gas and Electric more than four years, and was even offered permanent work. I attended public schools in Oklahoma City, Okla. I graduated at the top of my high school class from Douglass High School, and experienced the first, to my knowledge, diversity recruiting efforts by the then department head, Dr. William Hughes in Electrical Engineering from OSU. His efforts were successful in recruiting some 20 of us from Douglass. Much to his credit, seven of us later graduated. Today, I bring leadership to students, faculty and staff in the effective and efficient management of a modest research and development program for the College of Engineering at Tuskegee. We are a top producer of engineering graduates who
possess the technical talent to compete in industry, government, and academia. We perform research in such emerging areas as, batteries and fuel cells, modeling and simulation, cyber security, aerospace and flight dynamics, building informatics and management technology, materials science and engineering, sensor technology, environmental, bio-materials and thermal science, and alternative energy. For me, my interest has continued in signal processing, coding theory, information theory, communications, engineering education, and effective leadership and management. In the past, I have held positions as Dean at the Defense Systems Management College (DSMC), vice commander of Air Force Reserve Officer Training Corps (AFROTC), member of the Defense Secretary and Air Staffs, Pentagon, and division chief, National Security Agency (NSA), operations officer for Secretary of the Air Force Special Projects. I retired from the Air Force at the rank of colonel. More importantly today, I have served on the advisory board for the National Science Foundation (NSF) Engineering Directorate, the Advisory Committee on Government Performance Assessment, Northwestern University. McCormick School of Engineering, Advancing Minorities’ Interests in Engineering (AMIE), Historically Black Colleges and Universities (HBCU) Council of Deans of Engineering, and the National Society of Professional Engineers (NSPE). I served on the National Academy of Engineering (NAE) Study on the Engineering Studies at Tribal Colleges. Of particular interest, I have captured support from the National Action Council for Minorities in Engineering (NACME). I continue to author numerous articles and have served as a member of the American Society of Engineering Education (ASEE), Engineering Deans’ Council (EDC) Public Policy Committee. I was elected to the ASEE Engineering Deans Council Executive Board. As part of the EDC, I chaired the EDC Committee on Diversity; served as a member of the ASEE Engineering Deans Institute (EDI) Colloquium Committee, and as a member of the EDC K-12 Engineering Task Force. Tuskegee continues to be active and transformational under my leadership. I have used my experience in national defense, academia, and the information technology industry to affect a dynamic program. NACME is important to Tuskegee University, and other partner institutions. Since its founding in 1974, NACME has become the largest private provider of scholarships in engineering for under-represented minority students. Since its beginnings, NACME has provided more than $124 million in aid to 23,000 students at 160 colleges and universities. Today, even more than 1,200 undergraduates and 350 graduate students are receiving support through NACME. NACME is a leading source of research information on the status of minorities in engineering education and employment and are active in the formulation of policy positions for improving opportunities for minorities in STEM. Through collaborations with several partners, NACME launched a national network of urban-centered, open-enrollment, high school-level engineering academies that will provide all students with a strong science and math education so that they will be college-ready for engineering study. By involving parents, community resources, local corporations and universities in the activities of the academies, it is expected that NACME will have the potential of dramatically increasing the presence of minorities in these fields. Institutions like Tuskegee University are proven performers in recruiting, retaining, and placing performance-ready engineering talent throughout the nation in industry, government and academia. Indeed, Tuskegee has a history of partnering with nonprofit, government and industry for supporting STEM endeavors. Tuskegee has been a top 10 national producer of African American engineers in recent decades. As such, Tuskegee is well known for its demonstrable record of enrolling and graduating U.S. minority students, particularly African Americans, in the engineering fields. The College of Engineering (CE) at Tuskegee University has continued to produce engineers, architects, scientists and construction managers. We continue to provide talent for industry, government, and academia by providing the workforce with diversity, especially with women and men who are predominately African American. But, our country needs a robust and varied mix of men and women who are talented technically. Tuskegee’s engineering program is doing its part in supporting the demand for engineers, as well as architects, construction managers, environmentalists, physicists, and the technological workforce, at the University. But, others need to also step up to share the load.

The Need for a National Strategy

A national strategy to advance minority participation in STEM is needed to leverage the country toward improved problem solving, adapting to technology and recognizing the complex nature of the global society. This vector must begin at K-12 with parents and industry and government and the community. Listed below are several approaches to increase the numbers of URMs and the overall balance of advancing STEM awareness, encouraging industry involvement, improving teacher preparation and enhancing talent development.

Tuskegee University Overview and Background for HBCUs with STEM Program

Tuskegee University is an independent and state-related institution of higher education. Its programs serve a student body that is coeducational, as well as racially, ethnically, and religiously diverse. With a strong orientation toward disciplines which highlight the relationship between education and workforce preparation in sciences, professions and technical areas. Tuskegee University also emphasizes the importance of the liberal arts as a foundation for successful careers in all areas. Accordingly, all academic majors stress the mastery of a required core of liberal arts courses. There are 105 HBCUs across the nation; at these institutions, there are 14 engineering programs. In 1965, in Title III of the Higher Education Act of 1965, Congress officially defined an HBCU as an institution whose principal mission was and is the education of Black Americans. Tuskegee was accredited and was established before 1964. The first HBCU, Cheney University in Pennsylvania was founded in 1837. Like Tuskegee, all HBCUs play a critical role in the American higher education system. For most of America’s history, African Americans who received a college education could only get it from an HBCU. Today, HBCUs remain one of the surest ways for an African American, or student of any race, to receive a quality education. While the 105 HBCUs represent just 3 percent of the nation’s institutions of higher learning, they graduate nearly 25 percent of African Americans who earn undergradu-
ate degrees. HBCUs, because of their unique sensibility to the special needs of young African American minds, remain the institutions that demonstrate the most effective ability to graduate African American students poised to be competitive in the corporate, research, academic, governmental and military arenas. Institutions like Tuskegee University demonstrate and enhance success in increasing minority achievement in engineering along with science and mathematics. Tuskegee is proud to share in developing this generation of achievers. The College of Engineering at Tuskegee is noted for its production of the best in technical talent for industry, government, and academia. As one of 14 producers of predominantly African American engineers from Historically Black Colleges and Universities, Tuskegee is noted as a key strength program and provides for success after college. Each summer’s activities culminate with an awards banquet highlighting the achievements of each student. In the past, we have given scholarships, smartphone/computers and commitment to internships. Our industry partners assist in making the awards banquet a significant event. Companies participate with contributions of promotional gifts, scholarship funding and commitments to internships.

The scholarship commitment is significant, with the better students receiving full tuition and educational expenses. As such, FASTREC is one of our key recruiting and retention programs, and it is critical that support continues at current levels for its success. This is a target program for high school students. Additionally, FASTREC provides an anchor for the continuation of successful students academically. Two and three-year FASTREC students further employ strategies for success that will include peer mentoring and tutoring, celebrating intellectualism, iteration on the personal road map, and aggressive monitoring by the Assistant to the Dean.

Tuskegee’s program is unique as the only engineering program in the UNCF. Programs like MITE and FASTREC are recommended as models for higher education to emulate.

HBCUs are Experts at Educating African Americans

- HBCUs graduate more than 50 percent African American professionals.
- HBCUs graduate more than 50 percent of African American public school teachers and 70 percent of African American dentists.
- 50 percent of African Americans who graduate from HBCUs go on to graduate or attend professional schools.
- HBCUs award more than one in three of the degrees held by African Americans in natural sciences.
- HBCUs award one-third of the degrees held by African Americans in mathematics.
- HBCU engineering programs award 30 percent of engineering degrees to African Americans while representing only three percent of the American engineering programs.

According to a 2004 McKinsey study, the average graduation rate at many HBCUs is

Programs for National Consideration

Currently, Mentoring into Engineering (MITE) is a one-week program at Tuskegee designed to introduce high school students to various aspects of engineering, and provide them with lessons learned in preparing for success in college. The program includes laboratory demonstrations, several design projects, lectures on college admission, financial aid, cooperative education, career opportunities and field trips. A secondary role of the MITE program is to bring students to the campus to introduce various aspects of college life. Freshman Accelerated Start-Up and Training for Retention for Engineering (FASTREC) is a summer session program at Tuskegee, supported with the assistance of industry, intended to provide high school students with adequate college level academic experience and orientation before embarking on programs in engineering and other STEM disciplines. Success of the FASTREC student is impressive with 100 percent graduation from college. This data addresses retention and persistence of the quality of students recruited to the program. Students are selected from high schools throughout the United States, based on their SAT or ACT scores and their high school grade point averages. Academic instruction consists of courses in mathematics, physics, chemistry, engineering graphics, and computer programming. Extensive tutorial and testing programs monitor students’ progress and achievement. Up to seven semester credit hours may be earned towards the Bachelor of Science Degree in Engineering. In addition, presentations by industrial speakers and role models are provided. As an introduction to the demands of engineering, students participate in open-ended design, specific project implementation, and CAD/CAM/CAE (Computer Aided Design/Computer Aided Manufacturing/Computer Aided Engineering) activities. These students engage in development activities for mobile technology developing applications for learning. In addition, cooperative education, orientation, presentations by industrial speakers and role models are provided for the summer session. FASTREC is recognized as a national model by the National Science Foundation and noted as a key strength program and

National Action Council for Minorities in Engineering, Inc. (NACME) 35
higher than the average graduation rate for African Americans at majority institutions.

**Expectations for Students Potentially Entering Engineering Programs**

Nationally, engineering deans expect high school preparation is needed if students are to be successful in Accreditation Board of Engineering Technologies, Inc. (ABET) accredited B.S. level engineering programs. There are clearly *minimum requirements* for entering engineering programs to be “on track” and subjects that are *recommended*, if available, but not necessary for adequate preparation. The consensus of the engineering deans is shown in the Tables 1 and 2.

Some explanation may be helpful regarding the content of the tables. First, it is important that students are still taking some mathematics during their senior year. If they have completed pre-calculus math as a junior, they should take some math class as a senior. Otherwise, both success in math placement exams and success in the first calculus course in college are compromised. We find that unlike riding a bicycle, mathematics skills do get rusty pretty quickly. Second, the tables assume that there is some study of literature and composition in the required English courses. Third, the science elective should be of sufficient rigor to prepare students for college level work. The recommended science courses may differ somewhat by the engineering discipline the student is interested in pursuing. It may be better to have that additional background in chemistry (chemical engineering), biology (biomedical or environmental engineering), or physics (electrical or mechanical engineering). The terminating physics course, if not AP Physics course, must be of sufficient rigor to adequately prepare students to enter college level work. Finally, the entries associated with engineering are simply suggestions. In many of the engineering academy schools, there will be four such courses that include subjects such as computer-aided-design, robotics, fluid dynamics, etc. These will certainly be very helpful to the student when entering an engineering program as long as they are relatively rigorous and demonstrate the application of mathematics and sciences to real engineering problems. While these courses may be hands-on, project-based courses, the math and science concepts applied should be integral—rather than simply incidental—to the curriculum taught. I am proposing a renewed American mindset regarding the focus on STEM. This is a new thinking and a paradigm shift, but it is important for our renewed competitiveness.

**Tuskegee University Past Performance: Successful Pre-Matriculation Enrichment Programs**

Institutions like Tuskegee University, particularly the College of Engineering, offer summer enrichment experiences as pre-college programs—MITE⁶ and FASTREC⁷ to high school students completing 9th, 10th, 11th, and 12th grades, respectively, in order to prepare and motivate them to choose and enter college programs in engineering. MITE is offered to high school students completing 10th and 11th grades. FASTREC is offered to students who have graduated from high school. These programs have been ongoing for more than 40 years and are models for success. The elements include the following: a) re-structured orientation program; b) a well-coordinated and aligned first year/freshman adviser component; c) freshman honors experience; d) sustained academic enrichment; and, e) convergence of academic and student support function to yield a holistic enterprise. The overall efficacy of the Freshman Year Program is assessed to both document gains in student learning outcomes and to guide iterative program improvements. Further improvement to retention is to enhance the second and third year of the matriculation experience. Many institutions have employed more aggressive strategies noted as “best practices” that have proven successful. Particularly, a continuation of peer-to-peer mentoring, mandatory sessions for all students and more incentives for excellent performance will transcend the post-first-year experience. Each first-year student prepares a road-map-to-success, however, we have found that this development requires iteration each year, and even each semester.

### Table 1.

<table>
<thead>
<tr>
<th>Required (Minimum high school preparation to be on track entering engineering programs)</th>
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<tbody>
<tr>
<td><strong>Math</strong></td>
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<tr>
<td><strong>Science</strong></td>
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<td><strong>English</strong></td>
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### Table 2.

<table>
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<th>Recommended</th>
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<tr>
<td><strong>Math</strong></td>
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<td><strong>Science</strong></td>
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<td><strong>English</strong></td>
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<tr>
<td><strong>Engineering</strong></td>
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</table>
A National Design Of The Best Practices

Institutions should consider the protocol below as the use of a multifaceted strategy evidenced by the following best practices that are continually being reviewed, evaluated and assessed for public support:

- On-going recruitment throughout the country to seek the best students (but all students will have access)
- Faculty/staff serving as mentors, guiding, and directing the development and special activities for students
- A 24-hour Student Development and Information Center with industry sponsors Social networking and connectivity for students
- An engaging first-year program
- Daily mandatory tutorials
- Seminar on Road Map to Success for freshmen students
- First-year transitional program
- Awareness and preparation in high school program
- A project-based K-8 program
- Technical tours that showcase: An awareness with technical and overview tours for K-8
- Industry engagement throughout the academic year
- Active alumni in industry and government for mentoring
- Student participation in national conferences and colloquia
- Active Career Fair: Diverse industry and government with graduate academe involvement
- Continual faculty development to engage 21st century students

Recommendations

A. Increase America’s talent pool by improving K-12 science and mathematics education.
B. Aid the infrastructure development for broadband access for every population center in the Nation with a county seat, a public library, and public schools; and, provide linkages to Internet hubs for others.
C. Strengthen research at engineering-centric universities that could potentially provide transformational flow of new ideas in collaboration with government, state and local performance and enhance industrial outcomes to enhance quality of life.
D. Enhance the military, science, industry and academic complex to engage in developing, recruiting, and retaining the best and brightest students, scientists and engineers in the United States through pipeline, post-secondary, college, graduate and post-graduate programs through scholarships and grants targeted at STEM areas.
E. Invest in corporations to ensure the U.S. is leads in global innovation in manufacturing, engaged and modernized patent system, and develop and support tax policies to incentivize and spur corporations to host sites and hire STEM disciplines in the U.S.

Footnotes

1. National Action Council for Minorities in Engineering, Inc. (NACME) support to Tuskegee University began 1997; Industry support to STEM began 1960; National Science Foundation (NSF) support in C-SEMS, S-STEM.
2. NACME Annual Reports.
5. Advancing Minorities Interests In Engineering (AMIE) (www.amiepartnerships.org); AMIE is an alliance of the HBCU engineering programs and corporate partners to enhance diversity, business and student development and national interest.
6. Mentoring into Engineering.
Written Testimonies on the NACME Special STEM Session

Eileen M. Campbell
Vice President, Public Policy
Marathon Oil Corporation

Summary
There is a critical need to increase the number of highly-qualified African American, American Indian, and Latino women and men in science, technology, engineering, and mathematics (STEM) careers, particularly in the “E” in STEM, or engineering education and careers, by using Federal programs and funding to help increase the presence of underrepresented minority students in the field of engineering. The “New” American Dilemma refers to the relative absence of African Americans, American Indians, and Latinos in STEM study and careers, and the requirement to reverse this situation to compete globally. Data shows that, although increases in minority participation in STEM have been achieved over the past nearly four decades, that progress has been marginal, and not steady enough nor substantial enough for the representation of minorities to approach parity with their presence in the U.S. population. (See 2013 NACME Data Book for comprehensive URM data)

At its 2009 NACME National Symposium in Vienna, Va., NACME issued a set of Calls to Action in four categories: K-12 education, higher education, government, and business. We were encouraged to see that in recent guidance sent by Office of Management and Budget (OMB) and the Office of Science and Technology Policy to the agencies with regard to the formulation of their FY 2015 proposals, not only did they highlight the importance of STEM, but they also highlighted the criticality of focusing on the issue of underrepresented minorities in STEM. We at NACME remain concerned that there is seldom an adequate focus level of support on having the diverse STEM workforce. It is this focus that led to the formation of NACME.

Nonprofits can play an important role in assisting federal agencies in advancing many of key goals. Nonprofits, such as NACME, are making extensive commitments to advancing minorities in STEM, and should be recognized for their role and their long-term, focused and sustained commitment to, and investment in the minority STEM arena.

Currently, federal participation is often limited to individual institutions or even institutional consortia. We believe and recommend that expanded opportunities be developed to support partnership initiatives with such proven nonprofits and their corporate and academic partners. We simply want to take the investments we are already making and maximize federal investments in this arena to advance federal goals and objectives through effective partnerships.

I urge you to ensure that the government continues to be an integral partner with corporations like Marathon and non-profits like NACME, in addressing many of the challenges presented by NACME’s data. By putting in place the appropriate funding and programs that provide STEM education and training for our underserved talent pool, we ensure that we will have the intellectual capital to reinforce our nation’s position as the world’s strongest economy and source of innovation.

Chairperson, Rep. Eddie Bernice Johnson (D-TX), Ranking Member, distinguished Members of Congress, ladies and gentlemen, my name is Eileen M. Campbell, and I am Vice President, Public Policy, at Marathon Oil Company in Houston, Texas. I am also an eight-year member of the NACME Board of Directors, a former Chair of the NACME Board of Directors from 2009-2011, and Founding Chairman of the NACME Policy Committee from 2010-2011. Marathon Oil Corporation has been a financial contributor to NACME since 1979, and a member of the NACME Board of Directors since 2005.

I would like to start off by thanking you for the opportunity to share my thoughts and insights regarding the critical need to increase the number of highly-qualified African American, American Indian, and Latino women and men in STEM careers. I am particularly interested in the “E” in STEM, or engineering education and careers. I also want to comment on how federal programs and funding can be used to help increase the presence of underrepresented minority students in the field of engineering.

Dr. McPhail has presented stark and compelling evidence to support what the NACME has referred to as the “New” American Dilemma: the relative absence of African Americans, American Indians, and Latinos in STEM study and careers, and the requirement to reverse this situation in order to compete globally.

The data shows that although increases in minority participation in STEM have been achieved over the past nearly four decades, that progress has been marginal, and not steady enough nor substantial enough for the representation of minorities to approach parity with their presence in the U.S. population. Even more disheartening, new barriers are being erected that will make it even more difficult to tap this source of talent.

Consider for a moment the deeper implications of the following data:
• By 2050, there will no longer be a majority race.
• In 2012, underrepresented minorities represented 31.2 percent of the overall population, 38.1 percent of college-aged students, and 39.9 percent of elementary and secondary school-aged students.
Underrepresented minority students are underprepared in core STEM disciplines in high school, as only 8.6 percent of Latinos and 6.1 percent of African Americans take calculus compared to 42.2 percent of Asian students, and 17.5 percent of non-Latino Whites.

In 2010, only 9.3 percent of Latino students, 7.4 percent of African American students, and 5.6 percent of American Indian/Alaska Native students planned on majoring in engineering.

Underrepresented minorities comprised only 12.5 percent of the total engineering bachelor’s degree recipients in 2011, 7.2 percent of engineering Master’s degree recipients, and 4.0 percent of all engineering doctoral graduates.

Underrepresented minority females earned only 2.9 percent of bachelor’s degrees, 2.0 percent of master’s degrees, and 1.2 percent of doctorate degrees in engineering in 2011.

Underrepresented minorities comprised 10.2 percent of employed engineers in 2010, and slightly more than 6 percent of all engineering faculty members.

Since 1977, underrepresented minorities have earned 11 percent of the 1.8 million plus undergraduate engineering bachelor’s degrees allotted. Too many leaders and policymakers have ignored this data and failed to recognize, or, perhaps, to admit that diversity drives innovation and that its absence imperils our designs, our products, and most of all, our creativity—all components of competitiveness. Marathon Oil Corporation recognizes that we must address the needs of an increasingly diverse U.S. population and a growing global market. We, therefore, require a diverse workforce of engineers to help us operate and compete in a global environment. The diversity of background, talent, and thought that they will bring to the sciences and engineering is our only hope of maintaining our country’s lead in technological innovation.

At Marathon, diversity and inclusion is a vital part of our business strategy and a high performance team culture is one of our core values. Our diverse workforce and inclusive environment make Marathon more than just a multifaceted employer. With a corporate culture that celebrates diversity and inclusion, we have the ability to be a multidimensional competitor. That is today’s Marathon.

At its 2009 NACME National Symposium in Vienna, VA., we issued a set of Calls to Action in four categories: K-12 education, higher education, government, and business. For the corporate sector, NACME recommended the following:

• Form partnerships with K-12 schools to promote STEM careers and education to underrepresented minority students, including providing STEM employees to serve as role models and mentors, offering on-site internships to students and teachers, and providing access to the latest equipment and software.

• Use political capital to prompt government to address the “New” American Dilemma and institute policies that support the education and career preparation of underrepresented minorities.

• Include recruiting underrepresented minorities as part of workforce development and hiring strategies, and broaden college recruiting efforts to include institutions that traditionally enroll large numbers of underrepresented minorities.

• Make diversity a basic part of company values and support diversity through policies and systems.

• Recognize the demographic changes in the American population and prepare to develop a workforce made up increasingly of women and people of color.

Now, with your permission, I would like to make a few recommendations with regard to federal policy and expanding minority participation in engineering, science and technology.

We at NACME remain concerned that there is still far too seldom an adequate focus and level of support on having the diverse STEM workforce. This focus led to the formation of NACME. We were encouraged to see, however, that recent guidance sent by OMB and the Office of Science Technology Policy to the agencies with regard to the formulation of their FY 2015 budget proposals, not only did they highlight the importance of stem, but they did also highlight the criticality of focusing on the issue of underrepresented minorities in stem.

We encourage this direction and urge congress to support this direction. We applaud the leadership on this effort by several members of congress, and of course, in particular by Congresswoman Eddie Bernice Johnson, whose legislation “Expanding Minority Participation in STEM” is most especially important.

We would also recommend that in advancing such goals, federal agencies recognize the important roles that nonprofit entities are making today. Nonprofits, such as NACME, are making extensive commitments to advancing minorities in STEM, and should be recognized for their role and for their long-term, focused and sustained commitment to, and investment in the minority STEM arena. Nonprofits can play an important role in assisting federal agencies in advancing many of their key goals.

Currently, federal participation is often limited to individual institutions or even institutional consortia. We recommend and believe that expanded opportunities should be developed to support partnership initiatives with proven nonprofits and their corporate and academic partners to advance the following goals:

• Providing expanded support and encouragement of public-private partnerships and federal– corporate–academic partnerships.

• Expanding scholarship and training opportunities for minority scholars. Organizations like NACME raise millions of dollars in scholarly support annually. Several federal agencies are striving to provide such scholarship support. In a partnership we can maximize these investments.

• While you will hear more about this from the next panel, federal policy calls for developing coordinated, regional partnerships to advance STEM training from the K-12 level and beyond. It is NACME’s policy, and a high priority, to develop regional partnerships. That is what we do and do well.

• Enhancing the participation of minority scholars in federal laboratories and centers of excellence. We can help expand and enhance this objective.

• And finally, one of the major concerns of several federal agencies is how to improve both the participation of minorities in federal science and research, and the quality off such research proposals. We can assist in this goal as well through corporate and academic partnerships and mentoring.
We simply want to take the investments we are already making and maximize federal investments in this arena to advance federal goals and objectives through effective partnerships.

I urge you to ensure that the government continues to be an integral partner with corporations like Marathon and non-profits like NACME, in addressing many of the challenges presented by NACME’s data. By putting in place the appropriate funding and programs that provide STEM education and training to our underserved talent pool, we ensure that we will have the intellectual capital to reinforce our nation’s position as the world’s strongest economy and source of innovation.

I would like to thank Congresswoman Johnson and the distinguished Members of Congress for the opportunity to testify before you today, and look forward to any comments or questions you may have.

Thank you.
On behalf of the Society of Women Engineers (SWE), I applaud the National Action Council for Minorities in Engineering, Inc. (NACME) for your leadership in convening a national symposium focused on issues related to advancing underrepresented minorities in science, technology, engineering, and mathematics (STEM). I am pleased to respond to NACME’s request for testimony, and look forward to working with you, our many congressional champions (Republican and Democrat), and other advocacy partners to advance this agenda.

Since its inception in 1950, SWE has been the driving force that establishes engineering as a highly desirable career aspiration for women. SWE strongly believes that dramatically improving the participation of women and talent from other underrepresented groups will address this increasing demand of STEM-based workers, while at the same time leveraging diversity to fuel the innovation necessary for our nation’s global competitiveness. As you formulate your legislative agenda, we are pleased to make the following policy recommendations:

- **Target resources from federal STEM education programs to high-need populations, and scale up tested models.** We will achieve a higher return on our investments in American competitiveness when congress focuses the government’s limited resources on underrepresented populations. Congress must also continue to support and expand programs with proven results in addressing diversity issues in the STEM fields, like those authorized in the America COMPETES Act focused on teacher training and recruitment and systemic reform of STEM education.

- **Assess student achievement in science,** so that schools can measure their students’ progress and determine appropriate improvement. This assessment would also ensure more class time be spent on science subjects, exposing more students to STEM fields. According to a 2012 paper prepared for the Noyce Foundation, instructional time for science in the elementary grades has dropped to an average of 2.3 hours per week, the lowest level since 1988. The paper also correlates the decrease in instructional time to lower scores on the National Assessment of Educational Progress (NAEP).

- **Enact recommendations from National Academies’ Beyond Bias and Barriers report,** which requires agencies that fund scientific research to host anti-gender bias workshops for agency program officers, university department chairs, and members of review panels; instructs such agencies to enforce existing federal anti-discrimination laws at universities and other higher education institutions through regular compliance reviews and prompt and thorough investigation of discrimination complaints; and requires that grant data composite information be collected, stored, and published. The STEM Opportunities Act of 2013 (H.R. 1358), introduced in March by Representative Eddie Bernice Johnson (D-TX), enacts many of these recommendations.

- **Use Title IX as a tool to eliminate the barriers that still exist for girls and women pursuing STEM programs.** Congress should conduct oversight hearings and call for enhanced agency enforcement. Policymakers should also undertake or fund a comprehensive education campaign to educate students and their parents, and STEM faculty, about their rights under the law. Federal agencies should initiate regular, systematic compliance reviews that have general relevance across institutions and that are consistent across funding agencies. The NASA Title IX reviews could serve as an example for such reviews; NASA’s two recent publications, *Title IX and STEM: Promising Practices for STEM and Title IX and STEM: A Guide for Conducting Title IX Self-Evaluations,* could serve as resources. Information from any federal reviews should be disseminated publicly to ensure that best practices receive widespread visibility and problematic practices can be identified and eliminated.

- **Funding for federal agency programs that promote equity for women and underrepresented groups.** Congress should continue to fund gender equity programs that examine ways to retain women in academic STEM careers. Congress should encourage broader participation in these programs by the STEM academic community, and both congress and federal agencies should disseminate information about successful programs.

One of the most daunting challenges facing engineering education today is attracting and retaining students from the entire spectrum of American society to the field. As the number of jobs requiring engineering and scientific training grows, the number of students preparing for those careers remains almost level, with women, minorities, and people with disabilities severely underrepresented. The innovation that fuels U.S. competitiveness is hampered by the homogeneity of the STEM professions, boosting the importance of the full participation of the U.S. population in STEM careers.

Some of the biggest barriers to minorities and/or women entering the STEM workforce include the following:
Lack of awareness of STEM careers and lack of role models: Many disadvantaged students and their parents may not be aware of available scholarships or career opportunities in the STEM fields. A 2005 Bayer study of parents of underrepresented groups in STEM showed that 59 percent of parents thought an advanced degree beyond a college bachelor's degree was necessary to have a job in science and engineering. When told that seven in 10 Americans working in science or engineering (S&E) today have a bachelor's degree or less education, 88 percent of these parents then felt that the S&E community needs to do a better job telling today's students about these job opportunities. Also, with the small overall percentage of STEM professionals currently who are women, minorities, or people with disabilities, there is a corresponding lack of role models, making it difficult for these individuals to see themselves as STEM professionals.

For the past several years, the National Academy of Engineering has been studying the messaging surrounding the engineering profession, and released the report, Changing the Conversation, which aims to message engineering in a different way and reach more women and underrepresented groups. To date, SWE has trained over 2,000 volunteers on the Changing the Conversation messaging through its Maximizing the Message effort.

Climate issues in academia: Studies like the National Academies report, Beyond Bias and Barriers: Fulfilling the Potential of Women in Academic Science and Engineering, have documented the institutional, cultural, and historical barriers that impede the greater representation of women and minorities in the academic workforce. Although the obstacles presented by the academic culture are becoming more subtle than the overt discrimination of the past, women comprise only 14.0 percent of tenured and tenure-track engineering faculty as of the fall of 2012. This is, however, a notable increase from women being only 8.9 percent in 2001. Tools like Title IX should be used to uncover policies, procedures, or practices that discourage women from pursuing education in the traditionally male-dominated STEM disciplines. These Title IX reviews should also discover and disseminate information on promising practices that could bring more women into the field.

Deficiency of qualified STEM teachers: Weak teacher preparation, teacher quality, and low retention of qualified STEM teachers may be present in schools in economically disadvantaged areas, which often have the highest concentration of minority students.

Without these key elements that have been shown to improve student performance, many children may be eliminated from the ranks of future scientists and engineers, due to the student’s lack of a solid foundation in STEM. Some students from these schools may decide to enroll in science and engineering studies in college, but may end up dropping out in frustration, due to their limited STEM skills.

SWE supports institutional policies or practices that are in place that could mitigate these challenges and have proven effective in successfully increasing diversity in the STEM fields. Some of these policies/practices include:

- Informal learning: Studies have shown that integrating more hands-on curricula and promoting participation in after-school programs have been shown to foster girls’ interest in STEM. The success of the SWE Santa Clara Valley Section’s GetSET program provides an example. Now over 20 years old, this program has served over 300 girls from underserved populations, providing a week-long session for each of the four summers the participant is in high school.

- Increased requirements of STEM classes for graduation: With most states now requiring two or more years of math and science for high school graduation, more girls than boys are taking chemistry and biology. According to the National Center for Education Statistics, in 2009, 73.4 percent of girls took chemistry in high school, versus only 67.4 percent of boys. Girls also outnumbered the boys in math courses through pre-calculus, but boys still slightly outnumbered girls in calculus courses (15.7 percent of high school girls and 16.1 percent of boys took calculus in 2009).

- Scholarships: The Commission on the Advancement of Women and Minorities in Science, Engineering, and Technology report, Land of Plenty: Diversity as America’s Competitive Edge in Science, Engineering and Technology, highlighted the financial barriers to diversity in the STEM professions. SWE currently awards more than $500,000 in scholarships nationally with additional scholarships offered by our local sections. Legislation, such as a reauthorization of the Higher Education Opportunity Act, is needed to ensure access to STEM education.

- Mentoring: An individual with a role model or mentor has access to both career and content advice, as well as a professional network. Professional organizations, such as SWE, the National Society of Black Engineers (NSBE), the Society of Hispanic Professional Engineers (SHPE), and the American Indian Science and Engineering Society (AISES), provide a community that fosters mentoring between and among engineering students and practicing engineers. Formal professional development programs by SWE and our counterpart organizations, through face-to-face sessions, web-based seminars, and podcasts, provide additional training to individuals from underrepresented groups to support their success.

- Gender equity programs: Programs with a mission of retaining women in the STEM fields, like NSF ADVANCE or those under the framework of “Women in Science and Engineering,” have developed promising practices that promote gender equity in the STEM fields.

In conclusion, we currently have an untapped pool of potential workers, and we must leverage the diversity of these individuals to fuel the innovation necessary for our future global competitiveness. We strongly support efforts to increase the participation of women and other underrepresented groups in the STEM fields.

SWE appreciates the opportunity to provide comments, and is committed to working with you, our many congressional champions, and other advocacy partners to increase the competitiveness and security of the United States by growing the STEM workforce through the expansion of its diversity. If we can be of assistance in the future, contact me or our Washington representative, Melissa Carl, at melissa.carl@swe.org.
Federal Policy Support For Middle-Skill STEM Pathways and The Community Colleges That Provide Them

Summary and Recommendations
Workers in STEM fields—science, technology, engineering, and mathematics—play a critical role in driving economic growth, and STEM employment provides a significant pathway to family-supporting incomes. Yet too many African Americans, Latinos, and Native Americans are underrepresented in the STEM workforce.

Recent research, however, provides the opportunity to open up new avenues to STEM careers for underrepresented populations who access post-secondary education through our nation’s community colleges. New employment and skill data highlight a previously overlooked fact—that one-half of all U.S. STEM jobs are available to workers without a college degree, requiring only a two-year degree or shorter certificate. These “middle-skill” STEM positions pay 10 percent more than other jobs with similar educational requirements and offer the promise of better long-term income and career advancement. Manufacturing, health care, and construction all offer middle-skill technical and production work requiring STEM knowledge. This “second” or “hidden” STEM economy creates significant opportunity for underrepresented minorities, especially those from low-income families, because they enroll disproportionally at community colleges.

Developing an efficient pipeline to train underrepresented minorities for STEM occupations would deliver great benefits to employers and regional economies, while simultaneously helping reduce racial disparities in income, educational attainment, and career opportunities. Unfortunately, community colleges typically have low graduation rates, due to both individual and institutional challenges. In order to open up middle-skill STEM professions for more underrepresented minorities, community colleges need significant transformation in the way they operate and support student success.

Fortunately, educators and policymakers can point to a growing body of research, knowledge, and experience about “best practices” that the highest performing community colleges have used to revamp their programs—from redesign of developmental education to better advising and earlier choices of more structured pathways to credentials. The federal government has an important role to play in helping community colleges and their partners provide more transparent and cost-effective routes to STEM employment. The following are recommendations for federal policy:

1. Use federal innovation and improvement funds—such as the proposed minority- and women’s education at historically black colleges and universities—within STEM disciplines. This will help increase the number of underrepresented minorities who enroll in STEM programs at community colleges, particularly in fields with high demand.

2. Revamp larger STEM education and training programs. This will require deep investment in existing programs and the creation of new ones. Federal leadership is needed to spur state and local investments in STEM programs—such as the proposed minority- and women’s education at historically black colleges and universities—within STEM disciplines.

3. Improve the connection between community college STEM programs and the labor market. Federal leaders can work with community colleges and their partners to create more effective outreach and placement programs for STEM graduates.

4. Use federal innovation and improvement funds to support the development of STEM programs at community colleges. This will require deep investment in existing programs and the creation of new ones. Federal leadership is needed to spur state and local investments in STEM programs—such as the proposed minority- and women’s education at historically black colleges and universities—within STEM disciplines.

5. Use federal innovation and improvement funds to support the development of STEM programs at community colleges. This will require deep investment in existing programs and the creation of new ones. Federal leadership is needed to spur state and local investments in STEM programs—such as the proposed minority- and women’s education at historically black colleges and universities—within STEM disciplines.

Introduction
Workers in STEM fields play a critically important role in driving economic growth, and STEM employment represents a significant pathway to family-supporting incomes and financial stability. Yet far too few individuals from underrepresented groups are among the ranks of STEM workers.

To date, the focus on STEM employment has emphasized jobs that require a bachelor’s degree or higher—and federal policy and investment have reinforced that focus. New research, however, has helped adjust the national understanding of STEM and the opportunities it presents. New employment and skill data have drawn attention to the large number of STEM jobs that require less than a bachelor’s degree. The data have also highlighted the critical importance of community colleges as a primary provider of college access for large numbers of underrepresented...
minorities in this country. The result is a growing national recognition that, with new approaches and support for reform, community colleges can be a launching pad for many more individuals to high-paying, quality careers in STEM fields, particularly for underrepresented minorities.

The federal government can play an important role in helping community colleges and their partners provide more transparent, productive, and cost-effective routes to STEM employment. This paper characterizes the opportunities for underrepresented minorities in STEM fields and the existing barriers to successful community college pathways. It concludes with recommendations for federal policymakers for improving preparation for the sub-bachelor’s degree STEM labor market.

The Role of Community Colleges in Providing STEM Opportunities to Individuals from Underrepresented Groups

STEM employment opportunities have doubled from 10 to 20 percent of total U.S. employment in the past century. Over the coming decade, STEM jobs are predicted to continue to grow far more quickly than non-STEM employment fields. STEM wages are far higher on average than wages in other fields. The average salary in STEM employment in 2009 was just under $78,000, compared to $43,000 for non-STEM workers. For Latinos and African Americans, whose average household incomes are $40,000 and $33,000 respectively, increasing their placement in STEM employment would help reduce racial income inequality in the United States.

Unfortunately, African Americans, Latinos, and Native Americans are significantly underrepresented in STEM professions. According to the National Academy of Sciences, these groups comprised 28.5 percent of the U.S. population in 2006 but only 9.1 percent of college-educated individuals employed in science and engineering occupations. To match their share of the overall population, the proportion of underrepresented minorities in STEM careers would need to triple.

Recent research from the Brookings Institution argues that most analyses of STEM employment in the United States have not differentiated sufficiently among STEM jobs by educational requirements. They therefore have missed an important fact about STEM employment: one-half of all STEM jobs are available to workers without a college degree—and these jobs pay $53,000 on average, 10 percent higher than other jobs with similar educational requirements. Many of these jobs can also be stepping stones to higher-skilled positions, many of which require going back to school for further education: over 40 percent of STEM bachelor’s or master’s graduates attended a community college at some point. In manufacturing, health care, and construction, a significant number of technical and production jobs require STEM knowledge. This “second” or “hidden” STEM economy, comprising well-paying middle-skill jobs, draws its employees from vocational schools and, in particular, from community colleges.

Underrepresented students, especially those from low-income families, enroll disproportionately in public two-year colleges. The hidden STEM economy—fueled by those educated at community colleges—therefore offers the promise of better income and long-term employment opportunities to groups underrepresented in STEM occupations. A more efficient pipeline from community colleges into STEM occupations would deliver great benefits to employers and regional economies while simultaneously helping reduce racial disparities in income, educational attainment, and career opportunities. For example, installation, maintenance, and repair occupations, which can be accessed by those with community college credentials, constitute 12 percent of STEM employment, one of the largest categories. Community colleges are typically the training grounds for high-demand, middle-skill industries such as construction, advanced manufacturing, and allied health.

Unfortunately, while community colleges are an increasingly important entry point to higher education and STEM careers for low-income, first-generation, and students of color, too many community college students fail to complete their chosen program of study, and a surprisingly large number of students never even enroll in a specific major; STEM or otherwise. Fewer than 30 percent of those who enroll in community college succeed in obtaining an associate’s degree within three years, and fewer than half who enter community college with the goal of earning a college certificate or degree have reached that goal six years later. There are many reasons for the high non-completion rate. Some are student centered, such as poor academic preparation, financial strains, and the difficulty of juggling work, family, and school. Others reflect institutional challenges, such as dysfunctional placement policies; overreliance on standalone remedial sequences; inadequate advising on careers, programs, and course taking; and limited academic and other supports geared to pushing students to completion. Federal, state, and institutional actions can help address both types of challenges to completion.

If students of color and first-generation students in community colleges are to enroll in, persist in, and complete STEM programs in greater numbers, a significant transformation of the way colleges operate and support student success is needed. It is necessary but not sufficient to focus on incoming student preparation and student financial or life barriers to completion. Fortunately, there is a growing body of research, knowledge, and experience on what it takes to help more students from underrepresented populations succeed in STEM (and other) community college programs of study. Colleges and state systems involved in reform initiatives such as Achieving the Dream, Completion By Design, Accelerating Opportunity, Complete College America, the Community College Survey of Student Engagement, and others have gleaned important lessons about how the highest performing community colleges revamp their instructional programs and student supports to help more students enter and succeed in high-value programs. These lessons are being translated into principles that should inform institutional leaders around the country—but should also inform the decisions of policymakers at the state and federal levels.

Priorities for Improving Middle-School STEM Pathways at Community Colleges

A recent Jobs for the Future (JFF) report published by the Boston Foundation summarized the latest national research on strategies that community colleges are
using to address critical obstacles that their students face in progressing and completing academic or technical programs that result in credentials with value in the labor market. These strategies, which emerge from the best available research and programmatic innovation, are summarized in the following table. From the perspective of pathways to middle-skill STEM credentials and jobs, these research-based reform strategies can be distilled into the following “best practice” principles:

1. Program design and curriculum is based upon current regional labor market information and analysis that is fine grained, up-to-date, and informed by employers and regional workforce institutions.

2. Career-focused programs provide more structure and a clearly defined pathway to jobs and careers that are in demand in the regional labor market.

3. Students entering below the necessary level of proficiency receive basic skills support that is accelerated and contextualized for STEM fields, with the goal of minimizing their enrollment in standalone developmental education courses.

4. Students understand their options through advising upon enrollment and are expected to select a broad pathway of study (e.g., STEM, liberal arts) early in their college experience, so they can move quickly and efficiently to completion.

5. Early warning systems, frequent and ongoing advising, and career guidance are routine components of student support and college experience.

6. Low-income students are connected to effective academic, social and financial supports that promote retention and persistence through STEM programs.

7. Associate degree courses and programs are aligned with those of public institutions in the state, so that transfer to senior institutions to pursue higher-skill STEM programs is seamless and credits transfer easily.

8. Student enrollment, persistence, completion, and labor market outcomes are continually monitored—and analyzed by college and major/programs—and used for continuous improvement of curricula and support systems.

There is much activity in states and colleges around the country to put these principles (and the requisite institutional infrastructure) in place. Some is foundation-supported (e.g., Achieving the Dream and JFF’s new initiative to promote regional STEM partnerships; Completion By Design). Federal funds through the $2 billion Trade Adjustment Assistance Community College Career Training Act have stimulated institutional, statewide, and industry-focused innovations in STEM pathways. For example, the Massachusetts Transformation Agenda, a statewide TAACCCT grant, includes all 15 of the state’s community colleges, several of which are Achieving the Dream colleges. The three-year initiative is redesigning an accelerated curriculum for nearly 150 career pathways—with an emphasis on STEM fields—and adding significant structure and support for students through “navigators,” who provide academic and career support to students both on campus and in job centers. Other colleges and their partners are moving toward this paradigm shift on their own, based on what they see working elsewhere—and the expectations of both employers and students.

While most community college policy is a state and local responsibility, the federal government can play important roles in supporting and providing incentives for states and institutions to pay more attention to the definition and delivery of high quality middle-skill STEM pathways. Our recommendations follow.

**Recommendations for Federal Policy to Improve Middle-School STEM Pathways**

1. **Use federal innovation and program improvement funds to promote “best practice” strategies to improve middle-skill STEM pathways through community colleges into employment that reduce completion and employment gaps for low-income and first-generation students of color.**

   The Obama administration has proposed a federal Race to the Top for Higher Education, based on the innovation funding of the K-12 Race to the Top competitions. If such a program is funded, or a similar program is constructed, it could encourage states to provide good incentives for institutions, individually and in groups, to develop comprehensive approaches to more productive STEM (and non-STEM) pathways for their students. It could also encourage states to enact policies that would support STEM pathway innovations, such as performance-funding formulas that reward outcomes in high-demand, high-wage fields; metrics that can help students, colleges, and state policymakers understand the education and employment outcomes for students, by major and program; and labor market information systems that capture regional trends more effectively for use by students and institutions.

   A competition promoting innovation and productivity among individual institutions or consortia, such as the Administration’s proposed First in the World Competition or some other version of an institutional innovation competition, would also allow institutions to test out best practices that advance middle-skill STEM pathways, as one of the areas evaluated. Additionally, other existing innovation funds managed by the Departments of Education and Labor, the National Science Foundation, and others (e.g., Workforce Innovation Fund, TAACCCT, the H1B visa program) should be shaped to help advance this middle-skill STEM pathways agenda.

2. **Promote better regional labor market information for use in STEM course design, counseling, curriculum development, and student outcome tracking.**

   As noted above, competitive funding opportunities for innovation and program improvement should be structured to support more effective regional labor market information (combining Bureau of Labor Statistics, real-time labor market information or LMI, and employer feedback) so that programs meet employer needs and are up-to-date and of high value to the employer. We recommend the federal government fund pilot programs for postsecondary institutions to use both traditional and real-time LMI to better align their advising and program offerings, and then measure the resulting student completion rates, job placements, and earnings. If the efficacy of better LMI and its use in helping more students prepare for high-demand occupations is demonstrated (resulting in a range of improvements such as higher completion, lower loan default, etc.), use of sophisticated labor market data for program improvement and student advising should be considered as a
condition for continued institutional participation in federal programs.

3. Use upcoming federal education and workforce reauthorizations (e.g., WIA, HEA, Perkins) to promote better middle-skill STEM pathways, including the academic, social, and financial supports that help students persist.

   A number of major federal education and workforce laws are due for reauthorization. Congressional committees should create incentives and directives for better alignment of the Workforce Investment Act, the Perkins Career and Technical Education Act, the Elementary and Secondary Education Act, and the Higher Education Act reauthorizations to support stronger, more effective middle-skill STEM pathways—from high school or for adults who are unemployed or are looking to advance in their field. Postsecondary outcomes should be measured across all programs, and data reporting required by these laws should be better aligned through common definitions and metrics across funding streams. Congressional committees should demand that better cross-system alignment be built into these reauthorizations so that sustainable transitions from one to the other—from high school to college or from adult education to credit pathways to good jobs—become the norm rather than the exception.

4. Conduct and/or fund research and evaluation of middle-skill STEM initiatives.

   While the evidence base on practices that have a positive impact on student success in community college pathways is growing, we need more information on the varied programs designed to motivate, attract, and keep students—particularly underrepresented minorities—in STEM pathways. Most research on the efficacy of retention interventions, such as mentoring, financial aid, advising, and work-based learning/apprenticeships, comes from undergraduate and graduate-level initiatives. The federal government should fund careful research on the best and most comprehensive middle-skill STEM initiatives. Federal support for research on its innovation and program improvement investments could highlight conditions that promote STEM pathways innovation success—including contextualized on-ramps, early choice of meta-majors, and work-based learning with employers.

5. Balance the federal investment in STEM pathways to place more emphasis on preparation for and success in middle-skill STEM pathways.

   The federal government invests $4.3 billion annually in STEM education and training. But as Jonathan Rothwell of the Brookings Institution notes, while middle-skill STEM jobs constitute about half of all STEM employment, undergraduate degree pathways receive only 22 percent of that $4.3 billion. Some rebalancing of these investments toward sub-B.A. pathways is in order.

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### RESEARCH FINDINGS

| Students who accumulate credits and enter a program of study early meet with better outcomes. |
| Move students into program streams and encourage them to declare majors early. |
| Students need more structure, fewer options, and frequent feedback. |
| Streamline curriculum; add mandatory orientation, proactive advising, and educational planning. |
| Effectiveness of traditional developmental education is unclear. |
| Reduce, accelerate, and contextualize developmental education. |
| Not all academic programs and careers require the same skills. |
| Build multiple, differentiated pathways aligned with the requirements of academic programs and careers. |
| Assessment tests are high stakes, and they are not the best predictors of success in college. |
| Use multiple measures to place students, and change test conditions to increase awareness and allow preparation and retest. |
| Interventions are expensive, but there is evidence that they lower cost-per-completion. |
| Make the case for upfront investments that lead to higher completion. |
| Small college-level pilots are difficult to scale up. |
| Begin interventions at scale. |
| College programs should align with workforce needs, and students should understand career outcomes. |
| Use labor market information when designing programs and to improve career advising. |
| College programs should align with requirements for transfer with junior standing, and students should take courses that count toward their major. |
| Faculty disciplinary teams build core curricula for program streams that introduce students to a field and lead students to the goal of choosing a major. |
Endnotes


5. Rothwell, op. cit.


7. Rothwell, op. cit.


9. Two excellent sources of new research on what works are the Community College Research Center at Teachers College, Columbia University, and MDRC.


Written Testimonies on the NACME Special STEM Session

Janet Bandows Koster
Executive Director and CEO
Association for Women in Science

Summary
The Association for Women in Science (AWIS), a national nonprofit organization that advocates for the interests of women in science, technology, engineering, and mathematics (STEM), strongly supports efforts to diversify the academic, government, and corporate scientific workforce. A diverse scientific workforce, as exemplified by race/ethnicity, gender, sexual orientation/gender identity, religion, color, national origin, disability, and age has been shown to benefit not only individual scientists and the science being accomplished, but also the national economy. The underrepresentation of minority women scientists in research universities shows a pattern that is more similar to that seen with all women scientists than to the pattern seen with minority men among science faculty. AWIS encourages individuals and academic institutions to support the fundamental work necessary to broaden participation of all women in STEM fields as well as to step forward and take a leadership role in the advancement of diversity in the STEM workforce.

Recommendations for Advancing URMs in STEM Education and Careers
• Provide department chairs and deans with professional development to inform their leadership decisions regarding departmental climate and evaluation issues.

• Assure that diversity training programs for managers and organizational leaders are built on evidence-based strategies and conduct rigorous follow-up to determine whether action has been taken and progress made as a result of these programs.

• Encourage administrators to establish and implement evidence-based strategies to increase the hiring and retention of URM faculty and to collect and report data on the progress made.

• Hold chairs and deans accountable for providing equitable start-up packages for newly hired faculty.

• Support and promote the development of programs, such as NSF ADVANCE, that seek to cultivate a broadly inclusive science and engineering workforce.

• Disaggregate recruitment, hiring, promotion and retention data to assist efforts to assess why the proportion of URM women in faculty positions lags behind that of URM men.

• Provide appropriate academic and professional mentoring for URM women in the STEM fields.

• Convene conversations with administration, faculty, and students to address issues affecting minority women in the STEM fields.

• Distribute responsibility for diversity and mentoring among academic staff and faculty members, including women and minorities.

• Encourage the participation of minority women in professional and leadership activities within and outside the institution.

Underrepresented Minorities in the Scientific Workplace
The Association for Women in Science (AWIS), a national nonprofit organization that advocates for the interests of women in STEM, strongly supports the promotion of diversity in the academic and corporate scientific workplace. A diverse scientific workforce as exemplified by race/ethnicity, gender, sexual orientation/gender identity, religion, color, national origin, disability, and age has been shown to benefit not only individual scientists but also the national economy. In fact, industries that have made efforts to enhance diversity in the workplace argue that increasing diversity can serve to improve innovation, productivity, and global competition. The numbers of women and underrepresented minorities (URM) in the STEM disciplines have greatly improved over the past several decades, but institutional efforts to recruit, train, retain, and promote their participation in STEM fields are still inadequate.

AWIS encourages individuals and institutions to step forward and take leadership roles in the advancement of diversity in the STEM disciplines. AWIS believes that a diverse scientific workforce will increase the variety of perspectives contributing to and approaches taken in the conduct scientific research and education in the workplace. This, in turn, can serve to enhance science and has the potential to generate a broader range of discoveries that will enrich all societies.

Underrepresented Minorities in STEM Education
Although the number of URM scientists and engineers is increasing, there is a continuing need for programs directed towards recruiting and training more URMs in STEM careers. In order to improve representation of URMs in STEM disciplines, academic institutions must continue efforts to create and sustain a climate in which URMs can realize their full potential. AWIS recommends that academic institutions:

• Support the continuation of programs that have demonstrated efficacy in the advancement of URM students in the STEM disciplines.

• Develop and rigorously evaluate new programs that offer URM students opportunities to engage in activities related to STEM fields, such as research.

• Increase the representation of URM in STEM faculty positions to facilitate mentoring relationships between URM students and STEM faculty members.
• Increase the number of URM STEM faculty to facilitate better science research, better science education, and a richer educational experience for all students.

**Underrepresented Minority Employment in STEM Careers**

Although the “urban myth” is that the number of URM s qualified for faculty positions in STEM fields is exceedingly small, studies supported by the National Science Foundation (NSF) and other research agencies show that the proportion of URMs in STEM fields has risen markedly in the past 30 years. The pool of African Americans and Latinos with doctorates in science and engineering is therefore considerably larger than generally assumed. Consistent with the increase in native-born minorities in the doctoral-level workforce in recent years, there is a higher proportion of URMs among younger workers than older workers. A major challenge remains how to increase the proportions of URMs reflected in the faculties of colleges and universities. AWIS asserts that the increasing number of URMs with doctorates in STEM fields should be reflected in a greater number of URMs hired as faculty. Although the case is currently the case, AWIS recommends that academic institutions:

- Exercise quality control in diversity training programs, and conduct follow-up to determine whether action has been taken and progress made as a result of these programs.
- Offer workshops that address diversity and cultural awareness issues to academic administrators and faculty.
- Provide department chairs and deans with professional development to inform their leadership decisions regarding departmental climate and evaluation issues.
- Encourage administrators to establish goals for the hiring and retention of URM faculty and collect data on the progress made.
- Assemble diverse search committees and coach the members on how to interpret evaluation letters written for URMs and women.
- Hold chairs accountable for providing equitable start-up packages for newly hired faculty.
- Achieve a representation of URM faculty adequate for their URM students, and provide evidence through published data.

**Underrepresented Minority Women in STEM Fields**

As our nation progresses towards an increasingly technological and scientifically complex society, it is important that every American receive an equal opportunity to achieve and contribute. AWIS strongly encourages programs, such as the NSF’s ADVANCE program, which seeks to increase the participation and advancement of women in academic science and engineering careers. At the undergraduate level, URM women are slightly more likely than white women to major in STEM fields, while at the doctoral level URM women are slightly less likely than white women to achieve a Ph.D. in STEM. Nonetheless, in 2004 and 2005 the number of Latina, African American, and Native American/Alaskan Native women earning doctorates in science, engineering and math totaled 1640, representing almost 12 percent of all Ph.D. ’s awarded to women in these two years. These numbers suggest that URM women offer the talent and knowledge to be essential to the future of U.S. science workforce. However, U.S. research universities continue to hire and retain fewer URM women among assistant professors than would be expected by their representation among Ph.D. recipients. The under-representation of URM women scientists in research universities shows a pattern that is more similar to that seen with all women scientists than to the pattern seen with URM men among science faculty. AWIS encourages academic institutions to support the fundamental work necessary to broaden participation of URM women in STEM fields. This can be achieved if academic institutions:

- Continue to support and promote the development of programs, such as ADVANCE, that seek to cultivate a broadly inclusive science and engineering workforce.
- Increase efforts to recruit minority women to faculty positions.
- Disaggregate hiring, promotion and retention data to determine why the proportion of URM women in faculty positions lags behind that of URM men.
- Provide appropriate academic and personal mentoring for URM women in the STEM fields.
- Facilitate regular meetings with administrative, faculty, and students to address issues affecting minority women in the STEM fields.

**Beyond the Double Bind for Women of Color**

Exacerbating the lack of women of color as scientist role models for all students is a pattern in which the few successful URM women are rapidly moved into non-faculty and non-science jobs. Administrators in universities, industry, government agencies, and non-profit organizations who wish to demonstrate diversity are attracted to the idea of getting 2-for-1. Consequently, the few women of color who are hired for faculty positions are often asked to assume administrative responsibility for both gender and racial/ethnic diversity, while they are still climbing the tenure ladder. If this occurred after they had achieved the rank of full professor and had made their mark within their scientific community, such recognition might be advantageous. However, asking them to carry the total diversity burden at their universities while still relatively junior not only removes them from the scientific community but, in most cases, undermines their scientific careers because of insufficient time to focus on teaching and research. AWIS urges administrations to:

- Spread the administrative responsibility for diversity and mentoring among all faculty members, including women and minorities.
- Facilitate the participation of minority women in STEM activities within and outside the institution.

**References**


Summary

ASME is committed to achieving a truly diverse and inclusive science, technology, engineering, and mathematics (STEM) workforce in the U.S. and all over the world. Specific to the U.S., ASME would like to proffer the following policy recommendations. In 2011, women were awarded 18.9 percent of engineering degrees, while African Americans and Hispanics represented only 4 percent and 9 percent respectively. While these numbers do represent significant gains from the 1980s, there is still much work that needs to be done.

The U.S. economy relies on the productivity, creativity, and entrepreneurship of all U.S. citizens. With the predicted changes in future U.S. workforce demographics, increasing the participation of women and underrepresented groups in the U.S. STEM workforce must become a 21st century national imperative.

We urge policymakers to strengthen and re-examine oversight of existing legislation and programs aimed specifically at broadening participation by underrepresented groups in STEM fields, including that which:

- Increases public awareness of STEM careers, including supporting efforts to foster outreach to all students, teachers, parents, and K-12 guidance counselors;
- Enables all students to have access to a rigorous STEM curriculum, hands-on laboratory experiences, and informal learning that increases academic performance and interest in STEM careers; and,
- Offers incentives and mentoring for women and underrepresented groups to pursue STEM coursework and careers, including teaching careers, and continue to provide professional achievement opportunities post-graduation and throughout their careers.

By dramatically improving the participation of women and talent from other underrepresented groups in the STEM workforce, the U.S. can leverage the diversity of these individuals to fuel the innovation necessary for our global competitiveness, as well as meet the challenges of a changing world.

Endnote

Written Testimonies on the NACME Special STEM Session

Rebecca B. Ramos
Program Coordinator
NACME and FGLSAMP Scholarships
Center for Diversity in Engineering and Computing
And Office of Student Access and Success
Florida International University

The objective is to provide improved educational and career opportunities for underrepresented minorities (URMs) engineering students in colleges or universities. Research universities have (high research activity) especially Hispanic and minority serving institutions. For instance, the NACME program at Florida International University (FIU) allows undergraduate students to obtain merit and need-based financial assistance and will provide them opportunities to participate in a broad range of student-centered activities including: peer tutoring, peer faculty, and industry executive mentoring, cutting-edge research, and industry and academic internships. Our FIU career center provides students with an array of developmental workshops and personal career counseling. The FIU NACME experience is designed to reduce the high attrition rate in STEM and adds additional programs such as Industry Internships and Peer Mentoring programs. The strong commitment from Institutional Leaders, and the support of the FIU faculty, administration and research centers will ensure that NACME Scholars will obtain meaningful mentoring internships and research experiences prior to the completion of their degrees.

The NACME Scholars participate in an extensive mentoring, internship, research, and career planning program that will lay the foundation for the successful completion of their degrees and for careers in industry and academia. By engaging FIU engineering URM students in a host of activities to proactively support the academic and social integration of transitioning students into their majors, this program will increase their retention and graduation rates and will facilitate the eventual entry of a significant number of traditionally underrepresented students into the workforce or graduate programs in their respective fields of study. It will thus play a major role in broadening the participation of minorities in these fields.

The lack of early exposure to research at the undergraduate level contributes, in a significant way, to the lack of understanding among undergraduate students about graduate work and research careers in academia and industry. The problem is particularly acute among minority students since many of them are first generation college students. Additionally, few faculty members in engineering, nationwide, are from URM groups, and very few minority-serving institutions are strong research institutions. There are many research activities currently being performed in the College of Engineering and Computing and these opportunities will be available to the NACME Scholars. To achieve this goal, the students will be mentored and engaged in carefully designed activities that will give them a wide range of necessary skills including research methods, appropriate domain knowledge, communication skills, team-work skills, and social skills. While actively participating in research, the students will be mentored by the faculty. Graduate students, having a wide range of skill levels and experiences in research projects, will serve as peer mentors and role models and will help guide students throughout their research projects. Students who participated in research programs and whose results are selected for publication through peer-review will be encouraged to attend at least one conference or workshop and present their research results.

Institutional Background

Florida International University, a Carnegie Research University (high research activity), is a Hispanic and minority serving institution with the highest minority student enrollment in the State of Florida, and awards the largest number of Baccalaureates to Hispanics, and the third largest number of Baccalaureates to underrepresented minorities in the nation in all disciplines combined. FIU’s freshmen students primarily originate from Miami-Dade County Public Schools and Broward County Public Schools, the 4th and 6th largest school districts in the nation, respectively. Miami Dade County Public Schools, with its sprawling urban system of more than 380,000 K-12 students (and over 435 public schools), is composed of a large population of minorities, specifically, 90 percent minority (65 percent Hispanics and 25 percent Black).

The majority of AA degree transfer students entering into the engineering programs originate from the various community colleges within Florida, but mostly, from Miami Dade College (MDC). MDC is the largest college in the nation with over 160,000 students attending one of its 11 campuses or educational centers.

FIU offers students the opportunity to evolve in a culturally diverse environment and participate in south Florida’s international business activity while in school. With 50,000 students as of Fall 2012, which included students from almost 50 states and more than 130 foreign countries, FIU is the largest university in south Florida. The demographic breakdown of FIU’s student body is as follows:

- 63 percent Hispanic (31,500 students)
- 14 percent Black (7,000 students)
- 13 percent White Non-Hispanic (6,500 students)
- 4 percent Asian or Pacific Islander (2,000 students)
- 6 percent other minority groups (3,000 students)

The programs to support a learning community will proactively provide URM students with a variety of opportunities to participate in a broad range of activities designed to facilitate their academic and social integration. These programs will also allow students to transition into their
chosen majors and professions by directly focusing on addressing the well-defined factors that cause students to switch out of their intended STEM fields of study. The broad factors that have led to the low retention rates in STEM have been widely discussed and studied in the literature. In addition, our own experience, gained through many years of working with the predominantly Hispanic student population at our institution, suggests that the following are the key factors contributing to the student attrition in the College of Engineering and Computing at FIU:

• Inadequate support for academic, career, and personal counseling and mentoring;
• Being overwhelmed by the volume of material covered in the curriculum;
• Loss of interest in STEM and the belief that a non-STEM field is more interesting;
• Limited financial resources.

While there are many more factors leading to students’ decisions to switch out of STEM, the four factors cited above together represent a major subset of the roadblocks encountered by STEM students. To this end, we will implement a proactive advising and mentoring relationship with students to enable us to quickly identify student problems at an early stage before a decision to drop out is made, and to allow us to resolve the perceived problems by engaging students in appropriate activities throughout their academic careers.

The overall goal is to provide improved educational and career opportunities for URM students in the engineering programs in universities and colleges throughout the nation. The improved educational and career opportunities will facilitate student progress toward degree completion and eventual entry into industrial and academic careers.

The specific objectives are as follows:
• Increase educational opportunities for URM students by providing financial support for the engineering programs during their academic careers.
• Increase the retention rate among URM students by establishing a learning community based on proactive programs to support their educational activities.
• Increase the number of underrepresented students that are successful in the engineering programs at universities and who enter either a graduate program or are employed in their field of study.

These programs will be successful because:
• Its coordinated and intertwined activities effectively implement the key elements of known best practices shown to be effective in increasing retention (i.e. tutoring, faculty and peer mentoring, active participation in cutting-edge research, industry internships, academic, career and personal counseling, and financial support);
• A strong faculty and administration support and participation, which is the key to implementing successful mentoring relationships with students. The faculty are either leading or involved in numerous research projects and have experience in successfully mentoring students participating in previous programs, mentoring students in graduate and undergraduate research and in the clubs and societies in our college;
• It enjoys support from university research centers as well as industry leaders, who will provide students with meaningful advanced research and internship programs. We believe that these experiences will convince the students to stay in STEM disciplines and they will either pursue graduate studies or a career in a STEM related field;
• The University Office of Career Services has committed to provide students with appropriate training (such as resume writing and job interview skills workshops) and resources (i.e. invitation to on-campus interviews, career fairs and access to employer lists) facilitating their successful entry into the workforce;
• Our large, predominantly underrepresented student body (approximately 50,400 students, 63 percent Hispanic, 14 percent African American) will facilitate the recruitment of highly qualified scholarship recipients whose ethnicity will reflect that of our student population and who will act as role models to our other minority students.

The following are FIU Statistics for 2012 on URMs:
Dashboard Annual Accountability Report 2011-2012
Degrees Awarded by Ethnicity 2011-2012
Degrees Awarded by Ethnicity and Academic Year 2008-2012
Graduation and Retention Rates for Full-time FTIC Students 2002-2012
Graduation and Retention Rates for AA Transfer Students 2002-2012
Access to and Production of Degrees

Meeting Statewide Professional and Workforce Needs

Academic Year 2011-2012 Degrees Awarded by Ethnicity

2011-2012 Degrees Awarded by Ethnicity
Brittany Wilkins
Founder & President
SIE LLC

Highlights: My Journey to Becoming a STEM Professional

Curiosity, exposure, inspiration, and dreaming of impacting the world has led Brittany Wilkins to pursue a career in engineering. She is making an impact in the automotive industry as an Advanced Development Process Engineer, leading operation system improvement efforts and making products/processes cheaper, better, and faster.

Brittany’s pursuit of an engineering career began at Youngstown State University. She received her bachelor’s degree in Industrial and Systems Engineering. The road to becoming a STEM (science, technology, engineering, and mathematics) professional was full of many trials and tribulations. She was on the verge of almost failing out of engineering after being told she did not have what it takes to be an engineer, but eventually realized giving up was not an option.

Brittany overcame adversity through persistence, hard work, determination, and adopting a mindset that “successful individuals have to think differently to accomplish their goals.” After struggling to succeed, Brittany was nominated Women of The Year 2010 for her accomplishments in academic achievement in STEM.

Her pursuit of impacting the world extends far beyond her career in engineering. Now looking to educate, empower, and elevate more women and young professionals to impact the world, Brittany has founded Successfully Inspiring Engineers™ an academic support, coaching, and consulting firm to help increase the retention of underrepresented minorities in STEM. The organization’s mission is to provide personal and professional development programs that help women and young professionals succeed in college and life becoming leaders of today for tomorrow’s generation.

She believes that success means nothing if you are not reaching back to help others. This belief has led her to do outreach programs that inspire more youth to pursue careers in the STEM fields. Driven by faith and dedicated to service, Brittany is actively involved in her community serving as a mentor to FIRST Robotics Program and Girl Scouts Northeast Ohio.

Viewpoint (1)
STEM Education: A Cylinder from Different Perspectives

Inspiring our youth to pursue STEM careers has been a persistent challenge. Many programs, initiatives, and approaches have been implemented to help increase the retention of underrepresented minority students in STEM education. Yet we are still falling short. As we look ahead to the future, much discussion is focused on how we should shape the landscape of a STEM education to bridge the gap between what is being taught and what is necessary to succeed in the workplace. STEM education looks differently depending on perspective. STEM education can be viewed almost as a cylinder from different angles. From the side its projection looks like a rectangle, from the top a circle, and from an off-angle a cylinder. These different perspectives represent the K-12 pipeline.

Perspective 1: Rectangle K-4 education Attracting students at an early age will help engage them in the long run. Introducing them to science and engineering at an early age will pique their curiosity and stimulate the inner scientist within.

Perspective 2: Top of Circle 5-8 Retaining students in STEM requires that they be exposed. Hands on activities are the best method to teach students about mathematics & science principles.

Perspective 3: Off-Angle Cylinder 9-12 Excelling students in STEM by offering advanced placement courses that prepare them for college. Introducing them to role models already in the professions inspires them to consider a career in science, technology, engineering, and mathematics.

All three perspectives are valid and necessary. If we are to innovate, we must educate. We must retain students at every level in the educational pipeline, but we have to stretch beyond the cylinder. Inspiring students to pursue STEM education should not stop at the K-12 level. Engineers are born in K-12 education, but they are made in post-secondary education. The United States will not produce the workforce needed to compete globally if 50 percent of students cannot make the grade in their core curriculum courses in college. There is a need for programs and initiatives that help shape aspiring engineers and scientist’s future by helping them to succeed.

Engineers change the world, but we first need to begin by changing our educational system by designing, building, creating, and inventing a curriculum that opens the door of opportunity, not only leading students to STEM careers, but retaining them in engineering programs as well.

Viewpoint (2)
STEM Education & the Gender Gap

United States continues to remain at a crossroads in attracting underrepresented minorities in STEM, but more importantly, in attracting minority women to STEM. This has been a persistent problem that we have failed to provide solutions that help bridge the gap. According to a report conducted by the U.S. Department of
Diversity of women in STEM education and careers is lacking tremendously. Being an African American female engineer, I see evidence of this every day. I look to my left and to my right and I wonder why so few women in engineering. My work facility comprises more than 300 employees, but less than 12 percent of the population is women. In fact, the ratio of men to women in my work facility is so great that they had to start eliminating the number of women’s restrooms to accommodate the male population. I happen to be the ONLY African American female engineer in my work facility.

The even greater challenge that lies ahead in the corporate workplace due to lack of diversity is innovation. Where there is no diversity, there is no innovation. It is through diversity where innovations are born. Birthed are innovations that change the landscape of how we function and operate in society. From a global society perspective, innovation is lacking in our science and engineering enterprise system infrastructure. There are cracks in the infrastructure that are not enabling us to compete on a global level with our counterparts. In order to innovate we must diversify our workforce. Diversification consists of a workforce that looks like the melting pot of America. Diverse backgrounds, cultures, traditions, ideas, and perspectives bring collective and collaborative ways and methods of doing new things that advance our society. If we are to out-educate, out-perform, and out-globalize, then we must diversify the science and engineering enterprise system. This begins by diversifying the workforce and attracting more minority women into the STEM fields.

Viewpoint (3)

STEM Education Initiatives and Solutions

Improving the quality of a STEM education cannot be a one size fits all type of solution. If we want different outcomes in STEM education, then we need to change our approaches. First we need to understand the characteristics of underrepresented minorities which are the following:

* They come from diverse places.
* They come from different family backgrounds.
* They come from schools and communities with diverse resources and traditions.
* They come from a variation of different K-12 mathematics and science curriculum across schools, districts, and states.

More importantly, it needs to be understood that all learners are not created equal. Our society judges the intelligence of young girls and boys based on aptitude tests in science and mathematics. Tests should not be given to prove how smart students are, but should be administered as a benchmark to see what it is that the students know, and what a student needs to learn to be successful in academic courses. In our educational system educators are teaching students how to think as opposed to teaching them how to think. Students fall short of critical and analytical thinking skills due to lack of reasoning and mastering the basic fundamentals of science and mathematics. They are being taught to problem solve based off memory, not understanding. Student competence in core curriculum studies is being undermined, not because can’t learn but they are not being taught in a way that they understand.

Company’s Recommendations for Advancing Minorities in STEM

I recently founded my organization SIE LLC. My company is a “for profit” academic coaching and consulting firm seeking to increase the presence of minority women in STEM. What I am recommending and what my organization does differently, is to provide innovative and continuous improvement methodologies that help strengthen the science and engineering enterprise system to retain more women in STEM. These methodologies include lean six sigma principles from the DMAIC system. DMAIC is an acronym for defining, measuring, analyzing, improving, and controlling the root causes of why there are so few women in STEM. Working with a data analysis research statistician, we have developed learning style assessments that help us understand how women learn and think. The organization is investigating the potential for young women to be scientists and engineers. Based on how they learn, interpret, and comprehend information, we have designed a curriculum that best suits each woman’s learning style. We seek to develop the inner mind of young women. Studies have shown that one of the obstacles faced by minorities in STEM consists of habits of the mind. Building up the minds and self-esteem of young women is critical. A second ingredient for success in STEM is that students need to feel a sense of belonging. They want to feel part of a community. My organization has created a mastermind plan for women in college majoring in STEM. The mastermind group is designed to uplift the minds of minority women, helping them find their inner brilliance and learning style. We want to help them achieve success through visualizing goals, creating intentions, setting achievable goals, and providing resources that help elevate them to the next level. These goals are achieved through our proprietary signature system. This signature system takes a holistic approach in attracting, retaining, and excelling minority women in STEM. Our signature system includes three program levels: visualization, application, and elevation.

My recommendation is that we place more focus and emphasis in advancing minorities at the post-secondary level. This level is where the numbers of the numbers of participating minorities students begin to decline. There are so many barriers and obstacles that stand in the student’s way at this level. Many of the barriers include a lack of financial aid, academic support, social integration. Programs and initiatives need to be built around in providing solutions to these issues.

Some may wonder if this is the right path to be taken. I strongly believe it is. We need engineers now to fill the void in the corporate workforce left by the baby boomer generation, whose members continue to retire each year. We don’t have time to sit back and wait to train up aspiring engineers. We should put our time, energy, and resources on the students who are pursing stem education and careers at the post-secondary level.

56 2013 NACME Symposium Research and Policy Journal
General Session I
Catalyzing the Engineering Pathway for URM Students

Moderator
James Bryant
Texas Regional Coordinator
National Action Council for Minorities in Engineering, Inc.

Plenary Speaker
Vince Bertram, Ed.D.
President and CEO
Project Lead The Way
Catalyzing the Pre-Engineering Pathway for Underrepresented Minorities and Women: Project Lead The Way

Panelist
Kenneth Hill
President and CEO
Chicago Pre-College Science and Engineering Program
Increasing the Number of Students from Underrepresented Groups (African American, Latino) who are Prepared to Complete a College Engineering Curriculum

Panelist
Bill Taylor
Associate Vice President
Network Engagement and Growth
National Academy Foundation
College and Career Preparation for Underrepresented Minorities in STEM That Works
Catalyzing the Pre-Engineering Pathway for Underrepresented Minorities and Women: Project Lead The Way

Background: Project Lead The Way
Project Lead The Way (PLTW) was established in 1997 in Clifton Park, N.Y., with the goal of bringing rigorous, hands-on STEM curriculum to 12 area schools as a way to catalyze students’ lifelong interest in STEM. Sixteen years later, PLTW’s mission is to prepare students for the global economy. Our programs are in more than 5,000 schools in all 50 states, serving more than 600,000 middle and high school students annually.

Built on a foundation of leadership, innovation, continuous improvement, and accountability, PLTW focuses on three pillars: world-class curriculum, high-quality professional development for teachers, and an engaged network of partners. Curriculum is activity, project and problem-based and collaboratively designed by teachers and industry professionals. PLTW curriculum includes Gateway to Technology for middle school students and Pathway to Engineering and Biomedical Science for high school students. Recognizing that students determine as early as second grade whether they “like” and are “good at” math and science, a new PLTW elementary school program is piloting in 43 schools this year. A new computer science and software engineering program is also piloting this year in 60 high schools. All PLTW programs focus on instilling the crucial and transferable skills of critical thinking, problem solving, and collaboration that are vital in today’s workforce.

To ensure PLTW students receive the highest quality STEM experiences, PLTW partners with affiliate colleges, universities, and research institutions throughout the United States. These affiliate partners provide intense training and ongoing professional development to PLTW teachers. In addition to our affiliate partners, PLTW is supported through an engaged network of corporate and private partners, government organizations, professional affiliations, and other nonprofits.

Impacting Underrepresented Minorities and Women
Women and underrepresented minorities have historically accounted for a small percentage of engineers in the United States. Women, at most, make up 14 percent of the engineering workforce (Industry Market Trends, February 2013); while underrepresented minorities account for a mere 5 to 6 percent (National Action Council for Minorities in Engineering, Inc., 2011). This is unacceptable.

While PLTW programs are aimed at all students across the nation—regardless of school size or budget or student gender, ethnicity, or socioeconomic background—PLTW recognizes the vital importance of reaching underrepresented minority and female students and catalyzing their interest in STEM.

Dr. Robert Tai, in “An Examination of the Research Literature on Project Lead The Way,” November 2012, analyzes and summarizes numerous studies that identify the effectiveness of PLTW programs. After examining 30 studies and evaluations on the impact of PLTW, Tai concludes: “PLTW offers a well-designed and well-implemented educational program that appears to interest and motivate students in science and engineering as well as support achievement and academic performance, precisely the type of education we are likely to find most useful in reversing the flow of students out of the STEM pathway.”

Further, a 2011 dissertation, “Factors Influencing the Self-Efficacy of Black High School Students Enrolled in PLTW Pre-Engineering Courses” by Brandon R. Martin, points to PLTW’s success in increasing self-efficacy and reaching and catalyzing pre-engineering interest among underrepresented minorities through access to hands-on, relevant curriculum; participation in engineering environments; and exposure to engineering role models.

Anecdotal evidence also supports
PLTW’s positive effect on underrepresented minority students. At Toppenish High School in rural Yakima, Wash.—a school with a 95 percent minority population—nearly 100 percent of students are on free and reduced lunch. While real and perceived barriers to academic success are prevalent, the school implemented PLTW in 2009. Today, 50 percent of the student body is enrolled in PLTW programs and 48 percent of that enrollment is female. Since implementing PLTW programs, enrollment in AP STEM-related courses, students’ college-going rate, and scores on state exams have increased. Enrollment in pre-calculus has escalated 226 percent.

The evidence is compelling: Project Lead The Way works. It is working at Toppenish Middle and High Schools and in thousands of schools across the nation. Change the Equation’s evaluation and recent endorsement of PLTW as one of four STEM programs immediately ready for national scale bolsters the growing evidence supporting PLTW.

**Promising Practices: What Must Be Done**

The following best practices are essential to catalyzing lifelong pre-engineering interest among students and ensuring that underrepresented minorities and females significantly increase in the demographics of the engineering profession:

- **Break down real or perceived barriers to offering all students rigorous, hands-on K-12 STEM education programs.**

  Students will meet the bar—wherever it is set. Toppenish High School is a perfect example of school demographics that could have led to stereotyping about student ability and that often lead to low expectations. Instead, school leaders saw the potential effect PLTW could have on their community and made it available to students. The results of PLTW at Toppenish prove that students will respond positively to high expectations.

- **Identify and develop role models and internship opportunities with corporations.**

  Martin’s dissertation emphasizes the importance of role models and exposing students to authentic experiences in order to increase self-efficacy among African American pre-engineering students. PLTW consistently finds that when companies partner with PLTW schools to offer internships, tours, and connectivity with professionals, students see the real opportunities available to them in engineering, identify a career path, and better understand the relevance of their courses.

- **Expose students to exciting, relevant STEM curriculum, taught by engaging, prepared teachers beginning in Kindergarten and continuing through high school completion.**

  Students decide whether they enjoy and are good at math and science as early as second grade. That is why it is critical to reach students with interesting, relevant curriculum that turns them on to math and science and helps them understand these are essential tools to help them solve problems. When students develop the knowledge that all subjects are connected, they discover a richer understanding and ability to cross-functionally apply subjects. Harvard University educator Howard Gardner says the greatest deficit in American education is our students’ inability to apply learning in a context in which it wasn’t learned. Through PLTW, students develop the critical thinking, problem solving, and collaboration skills that are vital to narrowing the United States’ workforce skills gap.

**Summary**

Students will meet the bar wherever it is set. All students must be held to high expectations irrespective of gender, ethnicity, or socio-economic background. High standards, coupled with rigorous, relevant, hands-on STEM curriculum taught by engaged, prepared professionals make it possible for students to excel and develop the problem solving, critical thinking, and collaborative skills essential to the United States’ prosperity.

It is more important than ever for the U.S. to implement interesting, relevant, and rigorous STEM curriculum in schools; we must provide teachers and school systems access to training—and ongoing professional development opportunities—that catalyze their passion and talent for teaching STEM subjects; we must offer STEM programs to students in elementary schools and increase their knowledge and excitement through high school; connect and partner with businesses, government entities, nonprofits, and school systems that are committed to supporting STEM education; we must invite students into real-world environments in which STEM is applied, so they can experience both the exciting opportunities available and what it will take to achieve them.

**References**


General Session I
Increasing the Number of Students from Underrepresented Groups (African American, Latino) who are Prepared to Complete a College Engineering Curriculum

Panelist
Kenneth Hill
President & CEO
Chicago Pre-College Science and Engineering Program

The Chicago Pre-College Science & Engineering Program (ChiS&E) is an emerging nonprofit organization founded on three premises: (1) that the successful Detroit Area Pre-College Engineering Program (DAPCEP) can be authentically replicated in Chicago with local business, philanthropic, education, and community-based leadership; (2) recognition that early intervention is the best strategy for preparing a qualified labor force for the 21st Century and a fundamental driver of economic productivity; and (3) recognition that both cognitive and non-cognitive development are necessary for social and economic success.

The total number of individuals in the U.S. labor force with a college degree is expected to increase less than 2 percent between 2000 and 2020. At this rate, the lack of preparedness in the domestic labor force will lead science and engineering industries to increased global outsourcing, leaving fewer jobs at home. The vision of Chicago as a global city is threatened by this projected shortage of qualified professionals in the fields of science and engineering, including the underrepresentation of African Americans and Latinos. With a substantial number of top publicly held and private companies in science and engineering-related industries, the shortage will directly impact productivity growth in the Chicago area.

Chicago’s African American and Latino students are least prepared. Only a small percentage of the minority students who do graduate from high school are prepared to enter selective four year colleges where they could study science and engineering. A growing multi-disciplinary literature argues that remedial efforts at the high school level are too late and too costly. Early intervention, emphasizing development of both cognitive and non-cognitive abilities, with strong parental involvement, is emerging as the most effective educational strategy (Heckman and Masterov, 2006).

In this context, the Chicago Pre-College Science and Engineering Program will draw upon the best practices of the Detroit Area Pre-College Engineering Program (DAPCEP), which was founded in 1976 to engage young African American and Latino children and parents in learning science, engineering and mathematics. A 20-year tracking report (1976-1996) of the DAPCEP program indicated that 72 percent of DAPCEP college graduates earned degrees in engineering, science or mathematics related fields.

What Will It Take?
While public and private educational reform efforts are underway on the state and city level, there is no indication that the decline in labor force quality will be remedied. The pressing need for educational strategies to facilitate academic achievement in math and science for low-income students in Chicago (and across the nation) is unquestioned. Developing the answer—any answer—has been the difficult part until now. Research on early intervention strategies points clearly to the educational and economic efficacy of starting in early childhood (Heckman and Masterov, 2006).

Early Intervention
Many programs focus on remedial efforts for under-achieving youth, particularly high school students. A growing literature argues that high school is too late. Research indicates that remediation of early learning deficits is costly. “Remedial schooling, public sector job training programs and second chance GED programs are largely ineffective at current levels of funding.” What we now know is that the time to have the greatest impact is between ages one and eight. In today’s knowledge-based economy, critical thinking and communication skills are essential. To have critical thinkers ready for college in 2020, today’s four- and five-year-olds must begin to develop those skills now (Heckman and Masterov, 2006).

Cognitive and Non-Cognitive Learning, Parent Involvement
Building on the knowledge that early learning is critical for long-term academic achievement, the literature also reflects a strong emphasis on cognitive and non-cognitive abilities as twin pillars of achievement. Heckman and Masterov argue, “both cognitive and non-cognitive abilities are shaped early in the life cycle and differences in abilities persist. Gaps in college attendance among American youth across various social-economic groups are largely shaped by abilities formed in the early years. Gaps in child ability across family income levels are associated with parental environments and...
Early interventions can partially remedy these deficits. Later interventions are much less effective. At current levels of investment, American society over-invests in public job training and under-invests in early education.

Competitiveness in the Global Economy
While there is much debate about the shortage of scientists and engineers in the U.S. relative to the emerging Asian powers of India and China, there is consensus around the idea that to stay competitive in the global economy, America needs highly qualified professionals in these fields (Butz et al, 2003).

Growth in Science and Engineering Jobs
From an employment standpoint, science and engineering-based industries will continue to require highly qualified professionals. For example, the industry formally classified as “engineering services” is growing faster than the overall economy. The National Science Board (2004) noted that the number of jobs requiring science and engineering continues to grow. Since 1980, the number of nonacademic science and engineering jobs has grown at more than four times the rate of the U.S. labor force as a whole. Nonacademic S&E jobs increased by 159 percent between 1980 and 2000, an average annual growth rate of 4.9 percent (compared to 1.1 percent for the entire labor force).

Recommendation
Corporations, universities, parents, public schools, federal, state, and local governments should consider putting more resources into providing extra-curricular academic Saturday and summer programs for African American and Latino children and their parents in grades K-5.

References
College and Career Preparation for Underrepresented Minorities in STEM That Works

Abstract
In 2007, the National Academy Foundation (NAF) launched the Academies of Engineering (AOE), to complement the Academies of Information Technology as its STEM-themed offerings. Through the Academies of Engineering and partnerships with the National Action Council for Minorities in Engineering, Inc. (NACME), Project Lead The Way (PLTW), STEM Academy, Paxton-Patterson, and a host of engineering companies, substantial numbers of high school students from underrepresented groups are attaining higher academic results and entering college. This progress led NAF to launch Academies of Health Sciences (AHOS) to broaden the STEM-related themes it supports. The early results point toward the value of the career academy model to increase the numbers of underrepresented youth seeking STEM careers.

Background and Current Situation
Since its inception in 1982, the National Academy Foundation has demonstrated that the career academy model is highly effective in increasing student results in a variety of career fields. Research and evaluation confirm the effectiveness of NAF academies and its model:
- Fifty-two percent of NAF graduates earn bachelor’s degrees in four years—compared to 32 percent nationally.
- Of those who go on to post-secondary education, more than 50 percent are the first in their families to go to college.
- Ninety percent of students report that their academies helped them to develop career plans.
- Eighty-five percent of five and 10-year alumni are working in professional fields.
- In the 2012-2013 school year, NAF’s 230 STEM-related academies served nearly 32,000 students.

Beyond NAF’s own experience, an independent study of career academies by MDRC.org found that participation in career academies has a significant impact on the career prospects of participants, particularly young African American men. The labor market prospects of African Americans have long been troubling. Employment rates for African American men ages 20 to 24 have declined steadily since 1970, from 77 percent in 1969 to 56 percent in 2003, and the employment gap between young African American and young white men has hovered at around 19 percent throughout the past decade.

In 2008, MDRC released the results of its study that concluded that career academies are one of the few youth-focused interventions that have been found to improve the labor market prospects of young men. Their sampling of 1,400 career academy students, including NAF students in the eight years beyond their expected graduation, found that graduates sustained $16,704 (11 percent) more in total earnings than non-academy group members also studied:
- Young men from career academies experienced increased earnings totaling $30,000 (17 percent) above non-academy peers—thanks to a combination of increased wages, hours worked, and employment stability; and
- Young men from career academies had increased marriage rates by 9 percent over their non-academy peers and increased rates of custodial parenthood by 12 percent over non-academy peers.

MDRC concluded that, because more than 85 percent of those in the sample were Latino (56 percent) and African American (30 percent), the employment and earnings effects of career-academies were encouraging, particularly for young men of color, who are often left behind in the labor market.

NAF saw that STEM careers were going to experience substantial growth and earnings opportunities and established a partnership with NACME, along with PLTW and, later, STEM Academy and Paxton-Patterson, to launch the AOEs in 2007. Five years later, NAF launched a new STEM focused career theme, the Academies of Health Sciences (AHOS).

The Results are Coming In
NAF has been gathering data on its AOE students and the results are showing this approach to be highly effective. For example, see Figure 1.

The underlying reason for these results appears to be the combination of the elements in the NAF model: a focus on developing work-based learning opportunities starting in 9th grade, culminating in an internship; an active advisory board composed of industry professionals, particularly minorities; a small learning environment with high degrees of personalization; and, high quality, industry-vetted curriculum with well-designed professional development.

Where to Go Now
The demand for STEM workers has not abated. In fact, it has only increased. The U.S. Department of Commerce reports the following:
In 2010, there were 7.6 million STEM workers in the United States, representing about one in 18 workers.

STEM occupations are projected to grow by 17.0 percent from 2008 to 2018, compared to 9.8 percent growth for non-STEM occupations.

STEM workers command higher wages, earning 26 percent more than their non-STEM counterparts.

More than two-thirds of STEM workers have at least a college degree, compared to less than one-third of non-STEM workers.

STEM degree holders enjoy higher earnings, regardless of whether they work in STEM or non-STEM occupations.

The challenge in increasing diversity in STEM fields remains. As NACME reported in *U.S. News and World Report*:

“African Americans, American Indians, and Latinos account for 34 percent of the total U.S. population (ages 18 to 24), but earn only 12 percent of all undergraduate degrees in engineering. In fact, the share of engineering degrees earned by these three groups declines at higher educational levels: 12 percent bachelor’s, 7 percent master’s, and 3 percent doctorates. Meanwhile, women account for nearly half—46 percent—of the U.S. labor force but account for just 10.8 percent of U.S. engineers.”

The need for STEM professionals is high, the career opportunities for STEM workers excellent, the shortage of qualified people exists, the gaps for minorities remain, and the model for preparing minority high school students for college and careers is established. To meet the demand and need, more STEM-based career academies need to be created and supported.

**References**


![Figure 1. Profile of Academies of Engineering](image-url)
General Session II

The College Affordability Crisis

Moderator

Watson Scott Swail, Ed.D.
President and CEO
The Educational Policy Institute

Plenary Speaker

Justin Draeger
President
National Association of Student Financial Aid Administrators
Comments made at the NACME National Symposium

Panelist

Tina Farrenkopf
Director of Programs
American Indian Science and Engineering Society
Increasing the Representation of American Indians and Alaskan Natives in STEM Fields through the Full Circle of Support Model

Panelist

Michele Lezama
Executive Director
The National GEM Consortium
Comments made at the NACME National Symposium

Panelist

Chad Womack, Ph.D.
Director, Science Education Initiatives
UNCF
Comments made at the NACME National Symposium
Good morning. Thank you for the invitation to be here. I have a lot of respect for the things that NACME is doing and just keeping up briefly on all of the outreach activities and the model that they’ve implemented, the Academies of Engineering, the innovation grants, these are things that are not familiar to my population. Our job is partnering with high schools, looking for ways to tell students that despite everything that you hear, there is a pathway to college and there is a pathway to a career.

Just to give you a little background on National Association of Student Financial Aid Administrators (NASFAA), we represent student financial aid administrators. NASFAA member institutions serve 90 percent of all federal student aid recipients and we’re very interested in the college affordability crisis. Just one aside that’s not in my bio, I started out in social studies but as a fall back began dating a girl who was in engineering and married her and then followed her around the country for various jobs after college. So I have a lot of respect for the profession. She’s a materials science engineer which you all know is somewhere between chemical and mechanical and we actually met when we were 12 years old. In high school I enrolled in AP math, calculus, to be in the same class with her, scored much lower than her, but I won the prize.

So college affordability. I’m going to address: who pays for college, what is affordable, are we politically equipped to deal with college affordability and what is more important, affordability or success? Those are the major issues as I see it on student financial aid and affordability right now.

Let me start with the first one: Who pays? Looking at the big picture; higher education is different than a lot of other industries. Primarily because it is so subsidized and it’s been subsidized for a very, very long time. So when we talk about the price of college, that’s normally when we address affordability—the price that students pay. That price has changed over the last 40 years as a percentage of covering total cost of education. So if you looked at the price since 1980, it’s gone up about 7 percent a year if you average it out; 7 percent on the list price of college.

The inflation rate over that period of time has been around 3.2 percent so the idea that college cost or more accurately prices are rising at twice the rate of inflation is true. But the price isn’t necessarily what all students pay. Because of subsidization from the federal and state government, different students pay different prices. I touched on this. So if you look at just the cost of providing the education—not the actual price—the cost has run fairly congruent with inflation over the last 20 years.

So how can that be? If the cost of providing the education is going along with inflation, it’s a little above, but not anywhere near double, but the price has doubled, that just means price gouging for students. And what you hear in the press most often is, well, this college has this beautiful climbing wall and this college just built this fabulous dorm room. I went back to my college recently and quite frankly the dorms were a lot nicer than when I was there, but I still wouldn’t say that by choice I would go stay in them over a Hilton or a Marriott. It’s not the price gouging; it really comes down to where the subsidization levels have changed. So if we go back forty years and you look at the state government funding of higher education, you would find that for every $1,000 of per capita income that a state received, $10 of that would go towards post-secondary education. Now we come to today and that’s $6. Let’s just change the percentages and look at who is paying. So, 40 years ago about 65 percent of higher education expenditures were covered by states and local governments. The federal government was coming in historically around 10 percent. That’s changed in recent years because of massive influxes in federal student aid. Families covered 40 years ago roughly 30 percent of costs.

Today the federal government, especially after the last four years, is coming in around 16 percent. States are coming in around 30 percent. And students and families are coming in around 60 percent. So, using big round numbers, states and families have basically switched. Therefore, the first question I posed is important. Who pays? Whether we all agreed to this as a society or whether it just sort of happened with tight budget situations, the reality is that individual students and their families are now asked to pay a larger share of the bill and that affects the list prices, and it affects who is paying.

I think that’s important because it leads into the next big issue that you hear in college education, which is, the college debt prices: students taking on unmanageable amounts of debt. We have to ferret out the truth here as well because the average graduate today…if you graduate from a four year school, you’re taking on about $25-26,000 in debt and that’s a lot of debt compared to where we were 20, 30, 40 years ago. But over a lifetime of earnings...
the return on investment is still much greater, particularly in STEM fields. So, but then on the flip side, we just got numbers two days ago that showed us that within two years of leaving school, one in 10 federal student loan borrowers will default on their loans. That means going 270 straight days without making a payment and going into default. It does sort of appear like we have a problem if one in 10 are defaulting within one or two years; and 15 of 100 are defaulting within three years and one out of five are defaulting over the lifetime of the loan. Concerning the estimate that one in five are defaulting within the lifetime, certainly something is going on a little bit deeper. What we see is that the people who are defaulting on their loans, the people least equipped to deal with their loans, are people who don’t have $26,000 in loan debt. They’re people who, on average, have less than $10,000 in loan debt. And the number one stat, if we were to look at loan debt perhaps not causal but corollary statistic is that they dropped out of college. They went for a year or two, dropped out, too, on some loan and didn’t pay it back and went into default. And, I’m going to assume we all know that student loan default is horrible. The federal government will collect. You’ll just pay a lot more, lose your tax benefits and possibly Social Security. The federal government does collect on student loans.

So that to me leaves the questions as, if we’ve agreed, and I’m not saying that we have, that students and parents are going to be the primary payers of higher education, and the way that they are doing it is to finance through student loans, then we have to change the way we approach student loans. I tend to couch it in terms of, we don’t have a student crisis. I don’t know if we have an affordability crisis. What I do know is that we have fundamentally changed how we pay and who pays for higher education and if anything, if we are going to continue down this road collectively, then we have to change how students repay. And in other countries the way they repay is through the tax system. In New Zealand, Australia, Great Britain, when you pay your taxes you’re also, through payroll withdrawal, paying student loans as a percentage of your income.

There is a bill in Congress and it’s not getting much traction, like any other bill in Congress, but it addresses who is going to pay and creating a repayment plan that matches the situation.

The next question that I want to answer is what is affordable? What is affordable basically changes based on who you’re talking to. If we were to look at President Obama and Congress, what we would say is the conversation about what is affordable is couched in what are students getting for their money and how much are they earning after they leave college. Now I represent colleges and universities and so I don’t want anyone to think that I am against in any way looking at earnings as an outcome of college. That’s certainly one of the positive outcomes that we want. In fact, when you look at some of the surveys that come out of Georgetown, what we see is that the programs students go into have a larger effect on a student’s earnings than even the college that students attend. And if I were to pick a career right now solely based on income out of college, the career that I would choose is petroleum engineer because those are the ones that are in demand and those are the ones that are going to come out and make significant amounts of money within the first couple of years of leaving college. But if we look at aggregates and we take the entire pie of those who have graduated college, and we try to say on average if you graduate college, how much more will you earn over your lifetime, you’re looking at somewhere between $700,000 more over your lifetime than a high school graduate. If you even got some college, let’s say you didn’t even finish, you’re likely to end up even $300,000 more than a high school graduate.

So what the policy discussion is, is everything is focusing on how much are they earning. Are they gainfully employed? In fact, we have regulators who are working with negotiators, who have been appointed by various constituencies, coming together over the next few months trying to figure how we would measure gainful employment and it looks like some form of loan repayment combined with earnings, how much they earned. Here’s the challenge, and this puts engineers in a good place because immediately following college, two to four years down the road, engineers on the average are earning more than their peers at colleges and universities. Let’s look at other folks who didn’t go into engineering, like myself. I came out of college and didn’t make a living wage at my first job out of college. But over the 15 years that I worked after college, my degree allowed me to increase my earning potential. So trying to figure out in some mathematical, equitable way how we measure earnings is wrought with challenges. If the value system about what is affordable solely focuses on monetary return on investment and if it even crunches down further to say what do they earn three to four years after graduating, then we’re really doing ourselves a disservice in terms of college affordability.

So what are the policy suggestions, specifically? The Obama administration put out last year the college scorecard. Has anybody seen the college scorecard in here? The college scorecard is basically a snapshot of a college or university that has things like placement rates; it has the average debt levels. It has on the face of it pretty useful information, in terms of a snap shot. It doesn’t tell the entire story. One of the things that has been missing on the scorecard will be added in the next few weeks: the salary of the students who attend and graduate from that institution. This entire thing sort of leads to what I call the commodization of higher education: no longer worrying about breadth and depth, no more worrying about the soft skills, be it teaching people the ability to think. It’s all about what are you going to earn. And that’s what we’ve distilled higher education affordability into. I think that’s a detriment, particularly given some results of a survey out of Northeastern University that just came out in the last week. They went out and surveyed over 250 employers, asked them what was the most important thing and 76 percent of them said that the most important thing they were looking for in college graduates was the ability to think, the soft skills, communication, talk.

Now I don’t mean to downplay the hard skills, because 60 percent of them said the disciplinary training. That is the hard skills. But they felt like employers responded that they could teach that on the job. If they had a basis, they could teach the hard skills when they came and through internships and fellowships and first and second year training programs, but what they couldn’t teach were the soft skills, how to communicate, how to talk, how to work in a team,
work through problem solving. Those are the things that describe a liberal arts education. So what we hear a lot of is philosophy majors, English majors. Please, there are very successful philosophy and English majors. They may not necessarily be in engineering…but the point is that the conversation is really focused on those earnings and it sort of pushes the rest of higher education to the side.

The President has laid out a plan in three speeches and I can’t think of a President who has talked so much about higher education. This President clearly cares about higher education. The President laid out a plan where by 2015 we will start ranking colleges. The Department of Education will start ranking colleges based on how well they do things like keep costs down, serve low-income and underserved populations, and how well they do at moving students to success, graduating. So we’ll see the ranking as the first step, and it requires no Congressional action. The second thing that the President proposes is tying student aid to the ranking system. So if you’re an institution that’s at the lower end of that ranking system then you will conceivably get less financial aid in the form of Pell Grants, or student loans or campus funds for work-study. And if you’re at the top, then money will be diverted to those intuitions.

The third question I posed is, are we politically equipped to deal with the issue? No. Let’s move on. You’re here at a perfect time. D.C. is shutdown. You have this beautiful national zoo that you can’t even log on and look at the panda cam. So there’s the dysfunction on total display here. I won’t go into it, but in the federal student aid programs I want to point out that when we talk about a comprehensive solution to college affordability, whether it’s at the state level or federal level, all of it takes a back seat to the budget. All of it. In the last five years all of the significant changes in federal student aid have been enacted through budget, not through an authorizing process. An authorizing process is where committees get together and researchers come in and others and they talk about what we should be doing with federal student aid. That’s not how this has been happening. In the past five years all significant student aid changes have happened through the budget process. And all of those changes have been cuts.

So every year we’ve been saving the Pell Grant, let’s use that as an example. The maximum Pell Grant has not been cut in the last five years, in fact it’s increased. That’s great news. The Pell Grant is a successful program and it serves low-income students. In fact if you look at the distribution of the Pell Grants, a large majority of Pell Grant recipients are receiving full Pell Grants. That means we have families unable to make any contribution to higher education. It’s being utilized and it’s being utilized by the lowest income students. This is a good thing. The maximum has gone up, but there are two ways to cut a program. One way to cut a program is by cutting the dollars that the student gets, the second way is the way that we’ve done it the last five years and it’s a little more opaque and a little more insidious, and that is cutting who qualifies for it. In the last few years we’ve seen cuts enacted that disqualifies students from these grant programs. They cut the total amount that they can get. They’ve cut who qualifies for it, so the students who qualified for a Pell Grant no longer qualify for federal student aid. We’ve reduced when they can take it. We used to allow flexibility and innovation by allowing students to take Pell Grants on an ongoing basis so students could graduate in four years. Now we limit how often they can go to school. So that’s the way we’ve done higher policy in the last several years—one principle, consequences for students second.

Fourth: What is more important—affordability or access to higher education, or success, which has been more or less defined as completion? Federal student aid—if you go back to 1965 when the higher education act was signed—was really founded on two principles. The first principle was that the primary responsibility to pay for college was on the families. So in federal student aid, when we come up with what you qualify for, the first thing done was a needs analysis, where the federal government takes a limited amount of your financial data and information which now you can import directly from the IRS. Then it comes up with what your expected family contribution is. If it’s zero, then you go to the second principle of student aid, which is that no qualified student should be denied access to post-secondary education due to the lack of financial resources. So those were the two principles. Today I’d say we’ve added a third. The third principle is success and completion; that students who are admitted by institutions should be expected to progress, succeed and complete. Now, access and success aren’t necessarily diametrically opposed forces. But as any economist will tell you, as soon as we start putting money into the equation to try to develop some outcome like success, there are unintended consequences.

Let’s talk about some of the potentiality that exists there and what this could mean for STEM or underrepresented populations. If the money is following success, if we develop a college ranking system or some other system that rewards students attending schools where they are having a lot of success, what does it tell you about that student population? It doesn’t necessarily tell you that school is doing a heck of a job moving low-income students to success. It tells you that schools may be admitting students who are, predictively speaking, going to succeed. In fact, we looked at some data produced last year that showed that underrepresented populations in low-income families, that over 40 percent of them apply to no selective university—they don’t even apply.

This is why I have so much respect for the programs that NACME is working on, because these are the programs that tell students: ‘don’t discount yourself up front because you’re worried about how you will pay.’ If you get into a selective school, the selective schools fill out the rest of those pie charts I was describing earlier. They’re the ones that have funds to help students along, so we don’t want students and families disqualifying themselves before they even get to the threshold of application. But what we potentially could do—and this is something we have to be very careful of—is that if we decide on this new triad of success, access and family contribution, that by adding success in that there we don’t inadvertently give schools the financial motivation to suddenly choke off access. If they’re only going to accept students that are more likely to succeed, that’s a short cut. There are other potential short cuts maybe with grade inflations or in some ways, in some outside of the box way that schools might
be incentivized to help students succeed. But my concern is for the underrepresented populations, for the first generation college students that we retain opportunity, access. To me that’s no less important than it was in 1965. You know, I started talking about my wife a little bit and one of the things I wanted to end with is how important the work is that you are doing and supporting through programs, through financial scholarships, through grass roots programs that get the word out that there is a future in STEM fields and through college and through hopefully contributing careers. I’m a first generation college graduate, my wife is a first generation college graduate, and I am a proud federal aid recipient. I could not have made it through without student loans. And I’m still paying them back and I don’t feel any resentment about it. I could not have done it without federal student aid. When I was seven-years-old, you don’t remember a lot when you’re seven- or eight-years-old, but I do remember going down the street to a technical college where my mother walked across the stage and accepted a certificate in accounting. It was not a bachelor’s degree, it was a certificate in accounting. And if you grew up in my house, my father was military, he was Air Force and then Reserve Guard, but you would have thought my mother was the drill sergeant. She was hard as nails. I notice that she’s a little softer now she has grandchildren. What was so disconcerting was that I saw my mother cry as she accepted this certificate and I turned to my father and said, “why is mom crying?” I never saw my mother cry and he explained that she’s happy, she’s so proud. That made a huge impression on me about the importance of education. People know, understand that education is the doorway to opportunity. And I’d like to just leave an invitation that we all have a collective responsibility. Wherever all these questions end up settling over the next 5, 10, 15 years and whatever happens down the road here at Capitol Hill, we can make a difference in the lives of students by giving them an opportunity, a pathway to success. Thank you for all you do and thank you for the invitation to come and speak.
Increasing the Representation of American Indians and Alaskan Natives in STEM Fields through the Full Circle of Support Model

1977, AISES has worked to substantially increase American Indian and Alaska Native representation in STEM fields—as students, professionals, mentors, and leaders. AISES employs a “full circle of support” model that begins with pre-college programs, progresses into collegiate life, and then into the professional years of members and on into retirement.

American Indians and Alaska Natives and STEM
AISES is the only professional society established by and for American Indians that specifically emphasizes lifelong learning and educational achievement by utilizing cultural and traditional aspects within STEM.

Unfortunately, American Indian populations are the most underrepresented group in the country when it comes to education and graduation rates. With many schools poorly funded or in economic turmoil, achievement test scores are well below average and the high school dropout rate is nearly 15 percent. As a group, African Americans, Hispanics, and American Indians/Alaska Natives made up 6–7 percent of graduate enrollment in many science and engineering (S&E) fields (engineering; mathematics; physical sciences; earth, atmospheric, and ocean sciences; and computer sciences), 9–10 percent of graduate enrollment in agricultural and biological sciences, 15 percent in medical/other life sciences, 17 percent in social sciences, and 19 percent in psychology. AI/ANs accounted for 0.6 percent of master’s degree recipients in S&E fields in 2009 (154 degrees; increased from 0.5 percent in 2000) (National Science Board, 2012).

Many AI/ANs pursuing postsecondary education are members of the first generation in their families to do so. Providing AI/ANs with as many academic, professional and social supports as possible will begin to address their potential attrition from the mathematical sciences and increase their engagement as they consider pursuing higher education degrees and careers related to the mathematical sciences. AISES works to promote, initiate, and provide educational services for American Indian and Alaska Native pre-college, college, and graduate students in STEM. AISES also supports early-, mid-, and executive-level professionals in STEM through professional development, mentoring, networking, community service, and awards programs and initiatives. AISES is the only professional society established by and for American Indian and Alaska Natives that specifically emphasizes lifelong learning and educational achievement by utilizing cultural aspects with STEM. Through the quality and reach of its programs and the longevity and devoted commitment of its “family,” AISES is the undisputed leader in STEM opportunity in Indian Country. Members from over 200 tribal nations are represented within AISES, and AISES enjoys the support and partnership of corporate, government, academic, and tribal decision-makers.

What began in 1977 now comprises a robust platform, serving constituents from childhood through retirement.

• One hundred seventy-seven (177) chartered college and university chapters throughout the United States and Canada
• Thirteen (13) professional chapters
• One hundred sixty (160) affiliated schools that enroll more than 55,000 K-12 Native American students
• Nearly 3,000 current members
• More than a thousand Sequoyah Fellows (Lifetime members)
• Scholarship programs which have cumulatively awarded over $8.7 million to more than 4,900 students.
Strategies and Approaches
AISES utilizes a “full circle of support” model that is designed to serve our current and future members through myriad programs, activities, and initiatives that support indigenous Americans in their pursuit of educational and career success in STEM. AISES’ “full circle of support” model provides programming in three areas designed to feed the pipeline for and increase the number of AI/AN in STEM fields, including engineering.

The first programming initiative focuses on awareness and retention among pre-college students. Through its STEM Awareness and Retention Initiative, AISES engages in a multitude of programs and events that aim to ensure young American Indians and Alaska Natives (as well as their educators and families) are given exposure to first-rate STEM programs and events. These experiences and opportunities support students in discovering, pursuing, and sustaining their interest in STEM as they prepare for their college careers and beyond. AISES administers national events to support young STEM learners such as the National American Indian Science and Engineering Fair (NAISEF), and the AISES’ Power Up Science Fair Workshop. Further, as an Intel International Science and Engineering Fair Affiliate (ISEF), NAISEF grand award winners represent AISES at ISEF. Additionally, pre-college students (high school juniors and seniors) enjoy their own specific track at the AISES National Conference.

The second programming initiative focuses on undergraduate and graduate students, STEM Access and Success. AISES administers and is involved in many programs and events for American Indian and Alaska Native college students, graduate students, and young professionals in STEM. Whether they are a student or already in the workplace, AISES wants to support these young people in attaining success in STEM and in Indian Country alike—as a mentor, as a leader, as innovators. AISES is working to provide ongoing educational, community engagement, mentorship, networking, career-preparedness, and professional development opportunities for this service population. Programs under the Access and Success initiative include: scholarships, a Leadership Summit, summer internships, Regional Conferences, College Chapters, a job board, an events calendar, and e-news blasts about opportunities outside of AISES.

The third programming initiative, STEM Leadership and Change, directs its efforts to AI/AN professional members in STEM, providing a network of professional chapters and an annual professional awards program to celebrate excellence in the field—along with the Government Relations Council and Corporate Advisory Council that convene professionals in these arenas. Professional development opportunities are also delivered through the national conference. In addition, AISES continues to develop additional resources to connect professional members to each other and provide venues for continued mentorship, volunteerism and leadership development. These are important ways AISES encourages career retention and advancement for its members.

Just as important to our “full circle of support” model as our programs and complementing these programs is AISES’ national and regional events, which are designed to deliver top-tier educational and career-building skills, along with networking, mentorship, and traditional cultural opportunities to support AISES members in their STEM studies and/or careers. These include our Annual National Conference, the aforementioned Leadership Summit, regional conferences and the National American Indian Science and Engineering Fair.

Lastly, Winds of Change is a quarterly magazine published by AISES. It is the premier nationally distributed magazine with a single-minded focus on career and educational advancement for American Indian and Alaska Native peoples with an emphasis on STEM. In addition to its quarterly publication, Winds of Change releases an annual Special Top 200 College Issue that has come to be viewed as a crucial resource for students and college recruiters. Winds of Change is a proven valuable recruitment tool for corporations, government agencies, tribal and non-tribal businesses, and colleges and universities across the U.S. The editorial focus of this dynamically redesigned magazine honors tradition while exploring topics in STEM fields as well as health, education, business, and Indian culture.

Summary and Call to Action
AISES, through its “full circle of support” model, has made a difference in the lives of many who decide to enter into STEM fields, yet its work is nowhere near complete. Statistics show that despite its efforts (successful as they are) in the last 35 years, the AI/AN population still remains underrepresented in the STEM fields. Certainly, the “full circle of support” model requires funding (federal, private foundation and individual contributions), but more importantly, it needs commitment from educational institutions, corporate funders, private foundations and employers. This model works, but it takes time to see the return on investment. The support and commitment must be consistent and those offering it must be willing to nurture this process and be patient. The return on investment often takes years to develop as support networks, role models and peers are grown slowly in a community of STEM practitioners long underrepresented, but gaining in numbers. Progress, though slow, is steady and momentum will increase. Each year, AISES sees more pre-college affiliate schools, more college chapters and more professional chapters develop and its membership is increasing each year. The full return on investment is a long-term return, but well worth the wait.

References
Good morning. First of all thank you to NACME, particularly Dr. McPhail. I’ll first give a brief commercial. The National Consortium for Graduate Degrees for Minority in Engineering and Science, Inc. (GEM) is a 501(c)3 organization, and our goal is to increase the number of underrepresented minorities to pursue a graduate degree in a STEM field. We are institutional-based and consist of a number of employers and universities who come together to provide full funding for students to attain a graduate degree in a STEM field. We’ve been doing this since 1976 and now have over 3,000 GEM fellows. We have over 104 GEM member universities at this point, predominantly in the eastern part of the country, as well as a national footprint, and we have over 40+ GEM employer members who provide contributions toward fellowships and members who provide full tuition and fees. We are run by a board of directors. Our current president is Dr. Eric Evans who is a lab director, MIT Lincoln Lab. Our executive committee includes the Dean of Engineering from Georgia Tech, Dr. Gary May. Dean of Engineering, Dr. Daryl Pines is also a GEM alum and a number of other members are from universities, and national labs and industry members.

I’m the executive director and I’ll share with you my bio prior to being the executive director of GEM. In the immediate past I was executive director of the National Society of Black Engineers and prior to that I had a real life: I was director of technology in the technology areas of HBO television and CBS. Senior staff members of GEM include Dr. Marcus Huggins who heads our programmatic efforts and Dr. Michael Smith who’s in the back of the room who heads our operations. Our fellowships provide full funding, preferably to get a Ph.D., and that funding is including the fifth year of the Ph.D. program. We couple that with real life experience by providing required paid internships; two internships for master’s students and one internship for Ph.D. students. We provide programming to support our mission.

Our signature program in the undergraduate space is called GRAD Lab that stands for Getting Ready for Advanced Degrees Laboratory. We have GRAD Labs across the country. Our university members host these programs. They’re phenomenal. For those of you who represent universities in the room, please see me or Dr. Mike about hosting a GRAD Lab. It really changes the mindsets of underrepresented students and their thinking about what to do after undergraduate study. GRAD Lab teaches them that you can think not only about your job, but about a career and what the difference that a graduate degree can make in a career. We also have a program called FFP, Future Faculty and Professionals, and that’s a program to explain to current graduates what’s tenure? All these ABD, dissertations. You would be surprised how much graduate school lingo is out there that students are not aware of. And then we have an annual conference. This last August it was in San Juan, Puerto Rico.

As Justin explained to us in his talk, as far as the topic at hand of the affordability crisis of tuition in the U.S., the cost of going to college in this country has overwhelmingly exceeded the cost of inflation, and, as that top line portrays, as compared to the cost of education, books and supplies, the cost of housing is critical. We’re paying more for college than we are for houses over time. The clear answer to the question whether tuition is affordable is ‘no’. So, why is tuition rising so quickly? I think this graph gives a very concrete answer to that question and I’m going to add a few Michele Lezamaizms to this chart. The first one is demand; the ivory tower isn’t immune to the law of supply and demand. Universities are raising tuitions each year because they can, and families are willing to pay to play. So Justin talked about that inverse equation between families paying and governmental support. Marketing. I know, I have a college freshmen and a high school senior at home and I get so much material in the mail; pounds and pounds of paper marketing different programs across the country and explaining how you come to my institution and pay half a million dollars and your kid too can be successful. Administrative spending, university spending on administration per student has risen 6.1 percent in recent years as opposed to a 39 percent increase in instructional spending. And the last is the increase in government aid as Justin talked about earlier. As far as the cost for the tenure system, those costs are increasing but we’re not spending more per student.

This chart gives you a sense of what I think is important to this conversation: debt. Our ability to pay as Americans across demographics and across the country is relevant. For those of you who went to the Department of Energy meeting last week, Dot Harris gave a great stat as...
far as comparing the wealth gap within communities within the U.S. and she gave us a stat on net worth. And I have a B.A. in accounting and finance, which I know is challenging for an engineering audience, so net worth is simply how much money you bring in minus how much money you owe. How much money you have as assets and credits cards, and that mortgage and that car note is all subtracted. So the average net worth of a Caucasian family in the United States is $110,000. Let’s compare that $110,000 to underrepresented minority families: Hispanic net worth is $6,000, African American families is $5,000 and I find that to be a remarkable stat that really speaks to the ability to earn wealth in the U.S. When you compare that stat to the cost of paying college tuition we are talking about a true affordability crisis as it relates to college costs. This graph shows affordability according to where you live in this country. Iowa wins the award of the highest student debt by state, which considers the cost to live in that state and the amount of aid provided in that state. Bottom line is how much is tuition increasing? It is more than 500 percent increasing? It is more than 500 percent. The darker part of the circle represents 51 percent with over $30,000 in debt, as compared to white and Asian counterparts, 73 percent of whom had no debt. There’s clearly a gap as it relates to the ability to afford college. And to me it’s all about money. If students are going to feel that they can obtain a graduate degree, they have to feel that they have the ability to pay. If I have to take a loan out to pay a bill, that means I can’t afford it. So, when we think about net worth, that’s what we need; we have to educate these populations that’s what we’re talking about.

Then I want to talk a little about differential tuition. There’s this trend in this country where universities are charging different tuition amounts depending on what program you’re in. A part of that is because of the decentralization of colleges on campuses. Engineering is completely separate from business school; what tuition they charge is completely separate. So when we think of URM students who are already carrying debt to go into engineering fields, and then to continue that conversation at the graduate level, if you are charged more to go to engineering school, like I got an MBA and masters in engineering, if I had to make a choice, I am going to choose a program that costs me less. Universities are charging more because they say that they cost more. If we are really trying to encourage students to go into STEM fields, we should charge less for STEM fields and figure it out another way. Florida governor Rick Scott talks about differential tuition for STEM fields.

I want to show you a data chart put together by Texas A&M as it relates to who is charging more for engineering in this country. This is representative of 2010-2011 academic year. So this is happening: it’s a real cost of business and a market symbol. If we’re marketing that it’s going to cost you more and you already can’t afford it, are you going to pursue an engineering education vs. a non-STEM field?

I also want to talk about the MOOC affect—Massive Open Online Courses. I think this is going to be an opportunity for universities to really think differently about tuition. I’m sure most of you read in The New York Times that Georgia Tech’s offering the massive open online courses as it relates to charging individuals from around the world to actually get credit online at a top major institution. We have to look at that as it relates to affordability. We see trends. Dr. McPhail can attest to 45 percent of URM students in community colleges. We look at the report that’s in your bag containing the number of URMs who receive a zero or are in high school but don’t apply to selective colleges, instead going into the community college market.

It is an affordability or access issue we can discuss, but as we advance with technology, are we going to have an on-campus, country club environment for the majority of students and then have less access to these selective schools as this technology develops? However, will that also create a competitive environment for universities to think differently about tuition if you can provide access to STEM technology online?

So I’m going to conclude with the question “is college affordability in crisis?” We know this is true for underrepresented minorities in STEM fields and is only compounded given GEM’s mission and the focus on graduate school and STEM. Priority must be given to fund U.S. citizens across demographics, but particularly underrepresented minorities, to pursue and successfully attain a Ph.D. in the STEM fields. And how do we do that with this crisis in tuition? The last quote that I saw recently that I just want to read in conclusion, “if increasing the number of STEM Ph.D.s and particularly broadening participation among underrepresented minorities is to remain a national priority, the policies and practices that aim to support students in financing their education need to be examined. As demonstrated in prior research, concerns about accumulating large amounts of debt strongly influences students’ decisions to pursue or complete advanced degrees.”

I thank you for your time.
Good morning. Thank you for inviting me. I feel a little like a fish out of water. I’m a scientist not an engineer, which of course means I like to create problems, not solve them. This is going to be a little bit extemporaneous in that I didn’t quite know what to talk about until today and the advantage of being the last speaker is that you have a chance to listen to all the wonderful speakers that precede you. Not only were they great, they gave me great intellectual fodder, so I’m going to try to amalgamate my thoughts and give them to you in a way that I hope will be provocative. I want to start to talk about a major theme that I think has emerged and I want to reframe, if you will, the discussion a bit and provide a different critical theoretical lens on the conversation. I tend to invert things. I don’t know if it’s intellectual dyslexia. I tend to look at problems a little differently, like Steve Covey, start with the end in mind.

The purpose of higher education is not sacrosanct; it’s not self-justified. And it really should be seen in the context of empowering our nation’s youth to become innovators and entrepreneurs that ultimately will transform society. If we accept that as context for what I’m going to talk about, then affordability becomes a function of individual personal financial outcomes and, most importantly, communal impact. Affordability can be seen as a function of individual, personal, financial outcomes; how much one would make in the course of a lifetime with a college degree. And equally important is the impact the individual will have in one’s community. So if you take that individual’s success outside the context of the community, by definition, affordability goes down significantly. Likewise if they’re not able to earn a decent living then the question of affordability becomes obvious: that it’s not going to be affordable because they can’t pay their loans back. Ultimately the financial outcomes for the individual can fall into two categories: they become job seekers or they become job creators, and yes, job seekers can become job creators. People can work for a company like IBM or XEROX and leave and then start their own companies. But I don’t want to focus on the job creation side of it because we don’t talk about that a lot in the context of STEM.

Michele talked about a stat that we don’t really conceptualize well and we certainly don’t talk about, but one that I think is critical: the wealth gap. The wealth gap between African Americans, Hispanics, American Indians, white Americans, and Asian Americans is tremendous. And it’s growing. And let’s look at why that gap has persisted since Dr. Martin Luther King Jr. gave his “I have a Dream” speech back in 1963. The wealth gap has really fundamentally not changed that much. I would make the argument that the reason why it has not changed is not because African Americans or underrepresented Americans have not become educated; they have. But the difference is we have not really assessed the purpose of college. What is the purpose or end game for those who have pursued higher education? And if it’s just about job seeking, then I would suggest that we have poor definition of what the meaning of college education could and should be about.

So if we look at education, it’s really a function of two things: innovation and entrepreneurship. And we can define innovation as a process by which new things or new processes develop that improve outcomes or result in competitive advantage. That’s a working definition of innovation. Entrepreneurship is a process through which new businesses or organizations are created or established for the purpose of creating goods or services in a defined market. So if we look at the definition of innovation and entrepreneurship and we apply that in the context of job creation and ask what are colleges doing to prepare our youth to become innovators or entrepreneurs, one has to come away with the observation: not much. I am a proud graduate of Morehouse College and Morehouse School of Medicine. I went to Harvard and I’ve got to tell you, when I started a biotech company, I had no idea what valuation meant. I did well in math. I actually placed all the way through calculus and differential equations but stood in front of a group of angel investors who asked a simple question of what I was worth and I could not answer it, because I had not been prepared. I had no language or literacy in the skills of understanding what valuation meant for a startup company or for an entrepreneur who was developing a business, not just a technology.

Let’s go back to the wealth gap 20X differential between African Americans, underrepresented minority communities and white Americans and Asian Americans. Why is that? Well, when we look at the STEM industries, whether it’s bio, whether it’s engineering or whether it’s IT, we find a very startling observation. When we look at new companies that are formed, most are not formed by URMs; most are formed by white males and an increasingly smaller proportion of white females and Asian
African Americans don’t even register on the map. In my field, in bio-life science, I can count the number of African American Ph.D.s or Masters who started a bio-tech company on one hand. And that hasn’t changed in over 20 years. So it’s devastatingly important that we address the affordability question in the context of how colleges can prepare our youth to be innovators and entrepreneurs and ultimately prepare them to be the job creators.

Yes, job seeking is important and we can prepare them to do that. But we can walk and chew gum at the same time. I’m convinced of it. But we don’t really invest in our youth in terms of preparing them to be the cutting edge of where the economy is going, and that has to be around innovation and entrepreneurship. So, interesting statistic and data point for us to consider that all net new job growth over the past decade has been due to companies less than five years old and companies that experience a rapid growth and expansion; what they call gazelles, fast moving companies. Most gazelles in high growth enterprises are either tech-focused companies or tech-intensive companies, both driven by new technologies.

Finally, I fundamentally believe that all of our youth have an innovative and entrepreneurial capacity that is largely untapped, particularly underrepresented minorities. We have examples of universities that have adopted a different approach. Stanford has been at the forefront of that, but there are others. How can we learn from the experience that these cutting edge universities have provided? How can we broaden the impact of these types of programs to include minority serving institutions, HBCUs, Hispanic-serving institutions so that we have an opportunity to have an impact on that demographic of college-going students? I hope that we can continue this conversation. The UNCF will have an HBCU Innovation Summit out in Silicon Valley, California to talk about these kinds of things and the hope is that we can realign the universities and institutions with the economy. Thank you very much.
The Mathematics Conundrum

**Moderator**
Gina Hutchins  
Director of Engineering  
United Parcel Service

**Plenary Speaker**
Robert Moses  
Founder and President  
The Algebra Project  
*Improving Educational Access for Students Performing in the Lowest Quartile*

**Panelist**
Gregg Fleisher  
Chief Academic Officer  
National Math and Science Initiative (NMSI)  
*Increasing the Achievement and Presence of Underrepresented Minorities in STEM Fields*

**Panelist**
Vanessa Hill  
Professor  
Springfield Technical Community College  
*Scholarly Pursuits*

**Panelist**
Nathan Klingbeil, Ph.D.  
Associate Dean for Academic Affairs  
College of Engineering and Computer Science  
Professor of Mechanical and Materials Engineering  
Wright State University  
*A National Model for Engineering Mathematics Education: Uncorking the Bottleneck to URM Student Success*
General Session III

Improving Educational Access for Students Performing in the Lowest Quartile

Recently, we have begun to work in high schools where many students from underserved communities arrive achieving below grade level (cf Carnegie Foundation, 2013). We aim to enable students who enter high school performing in the lowest quartile on state or national mathematics achievement tests to graduate on time prepared to take credit-bearing college mathematics courses.

This ambitious goal is addressed with eight strategies that were initially developed at the lowest performing high school in Jackson, Miss., and with instructional materials later piloted in Petersburg, Va., and San Francisco:

- Keep students together as a cohort for their math instruction for all four years;
- Double instructional time for at least three years;
- Provide instructional materials that engage students and address the mathematics needed for college;
- Where possible, provide students with an after-school program to be mentored by older youth and to mentor younger students in mathematics (the Young People’s Project);
- Enable one teacher to follow these students through all four years, with ongoing support;
- Foster partnerships with local universities where faculty become involved in the classroom, in materials development, and are trained as professional developers;
- Develop local professional development capability among teachers and university partners;
- Strengthen the ability of parents and the community to support the educational advancement of their students.

Currently we are analyzing results of a National Science Foundation-supported study on five such cohorts started “from scratch” in different high schools beginning in 2009: Ypsilanti, Mich. (predominantly African American); Mansfield, Ohio (predominantly African American); rural southern Illinois (rural white); and two high schools in Los Angeles (one predominantly African American and one Latino). These cohorts were implemented with national support from the Algebra Project and Young People’s Project, with local variations that depended on local initiatives and resources. For example, in the large urban district of Los Angeles, our contract with experienced community developers OneLA-IAF (affiliate of the Industrial Areas Foundation) was key to keeping the project in place in schools and the district. Also essential was the dedicated work from local university mathematicians and math educators in classrooms. Impact on sites, teachers and students will be reported in spring, 2014.

Our experience, however, already indicates the importance of a whole school approach to educational improvement in these communities. As it is, this program is a radical intervention in a math department that comes up against many obstacles in school and district practices such as school and district funding for teacher positions, teacher assignment to courses, credits needed for graduation, counseling of low performing students, support for working with innovative materials, interim assessments and others.

Our most successful site was one where the community, school and school system were all committed to the program and where there was an excellent collaboration between teachers and the local university. This site was Mansfield, a small city of about 50,000 in central northern Ohio.

Students here had the best outcomes of the five cohorts, in terms of retention, graduation rate, aspirations and reported experiences. For example, of the 19 who constituted the stabilized enrollment early in first semester, who (all but one) entered performing in the lowest quartile on the Grade 8 state math test, 79 percent graduated on time. This four-year graduation rate can be compared with the rate for African Americans throughout Ohio for the classes of 2009 and 2010 (most recent
Many states, districts, and schools have made essential progress in changing teacher preparation and professional development to help talented educators enter and stay in the classroom. There have also been pushes for interventions like additional learning time, new curricula, and new technology, much of which has been shown to have a significant impact on student achievement. However, applied individually, each of these fails to get our schools and school systems where they need to be to serve every student. By purposefully integrating many of these advances in a comprehensive school design, much more can be accomplished than applying each individually (Carnegie Corporation Foundation, 2013, page 4).

One such effort is being made by a new high school in Los Angeles, Augustus Hawkins High School, where a group of project teachers have started a new school to integrate Project practices across subject areas in their Critical Design school-within-a-school.

Other High School Results to Date

- At Lanier High School in Jackson, Miss., Moses’ team worked with a cohort of students for all four years of high school in daily double periods. These students outperformed the non-Algebra Project students at the same high school on many indicators. For example, 69 percent of Algebra Project students who had remained in the project for two years graduated in four years, compared with 27 percent who were in the project for one year or not at all. This high school was historically the lowest performing of eight high schools in Jackson, Miss. And in two other low-performing high schools piloting the new Grade 9-10 instructional modules (Petersburg, Va., San Francisco), Algebra Project students outperformed their nonparticipating peers on the end of course test, especially on the functions strand (West, 2010).

- In a study of students’ thinking in three high schools, Algebra Project students showed understanding and problem solving abilities for basic function concepts on a level that compared favorably with incoming college students, and even pre-service teachers (Dubinsky and Wilson, 2013).

References


General Session III
Increasing the Achievement and Presence of Underrepresented Minorities in STEM Fields

Panelist
Gregg Fleisher
Chief Academic Officer
National Math and Science Initiative (NMSI)

Abstract
Two major problems contributing to the U.S. science, technology, engineering, and mathematics (STEM) crisis are the lack of student engagement in STEM subjects and the shortage of qualified STEM teachers. These issues are interrelated and the U.S. STEM crisis cannot be remedied without a comprehensive and well-rounded approach to ensure that both students and teachers are on a path toward success. NMSI’s approach to these problems has focused on scaling effective programs nationally. This white paper highlights the major components of the Comprehensive Advanced Placement and UTeach Programs, how they aim to address the STEM crisis, their relative successes, and how NMSI has increased student outcomes among minority groups in STEM subjects.

Background and Problem
This year marks the 30th anniversary of A Nation at Risk, a seminal report that warned of a “rising tide of mediocrity in the nation’s schools.” Despite the report’s clarion call to dramatically improve America’s schools and maintain the country’s “slim competitive edge,” the U.S. education system is still mired in mediocrity, continually bested by those of other countries. As a result, there are about 4 million unfilled jobs in this country, even though 12 million Americans are out of work. Many unemployed Americans simply do not have the educational background and skills to fill those jobs. McKinsey & Co. reported that the academic achievement gap between children in the United States and other countries deprived the U.S. economy of as much as $2.3 trillion in economic output in 2008. These economic impacts are exacerbated by an increasing scarcity of workers qualified to fill crucial positions. Consider these facts:

- The knowledge economy is increasingly dependent on college-educated professionals. By 2018, the economy will have created 46.8 million new jobs.1
- Nearly two thirds of these will require workers with at least some college education, with a slight majority of these requiring workers with a bachelor’s degree or better.2
- But current college completion can’t meet this need. The U.S. Census Bureau reported in 2010 only 39 percent of non-Hispanic whites ages 25-29 had bachelor’s degrees; the numbers were even less for African Americans (19 percent) and Hispanics (14 percent).3
- In addition, there is a shortage of graduates in STEM-related disciplines. Economic data show that 1 million additional STEM graduates will be needed over the next decade to fill America’s economic demand. STEM-based jobs are expected to grow 17 percent in the next 10 years, outpacing the overall job growth of 10 percent.

Undeniably, STEM education in the U.S. is lagging behind, and there is growing momentum to remedy the situation. The National Math and Science Initiative (NMSI) was founded to address one of this nation’s greatest economic and intellectual threats: the declining number of students who are prepared to take rigorous college courses in math and science and be equipped for careers in the knowledge-based economy. As we create strategies for promoting STEM education, it is important to create best practices based on proven programs and measurable results. NMSI was launched in 2007 to transform schools to prepare students for success by building strong foundations in science, technology, engineering, and math. NMSI achieves its mission nationally by inspiring and engaging students to develop strong interest in STEM fields, transforming schools into centers of college-readiness and producing, training, and retaining content-rich teachers. NMSI works to increase instructional rigor in the classroom based on best practices from our first-hand experience in implementing programs with proven effectiveness and quantifiable results.

Its ability to increase student outcomes after only one year of program implementation is what makes NMSI unique in education. For example, NMSI has collected extensive data on schools following its methods for improving student achievement and its impact on AP programs in high schools across the nation. In NMSI program schools, the average increase in AP qualifying scores in English, math and science is 79 percent in the first year—11 times the national average—and 137 percent after three years, almost six times the national average of 24 percent. NMSI’s results are even more impressive for under-represented groups: qualifying scores for African American and Hispanic students increased an average of 107 percent in math; female students increased an average of 84 percent, 12 times the national average. These results in improved student outcomes in mathematics and science are extremely important in light of the STEM crisis in America.
Promising Practices & Solutions for Solving the STEM Crisis

NMSI believes that adequately preparing students for career and college readiness is essential to solving the STEM crisis. U.S. college readiness is not where it needs to be. Only 70 percent of students in public high schools graduate, and only 32 percent of students leave high school qualified to attend four-year colleges.

The statistics are even worse for minority groups: only 51 percent of African American students and 52 percent of Hispanic students graduate, and only 20 percent of African American and Hispanic students leave high school college-ready. According to Complete College America’s 2012 report, 1.7 million students entering college required at least one remedial course, which cost states and students more than $3 billion annually. How do we increase career- and college-readiness, college enrollment and graduation, and STEM degrees among minority groups? At the National Math and Science Initiative, we find that there are three key factors that contribute to student success across all groups—student engagement, motivation, and exposure to STEM subjects.

Student Engagement

Students who are engaged and active in the classroom are more apt to increase their critical thinking skills. Of course, this is highly contingent on the teacher’s classroom instruction, and that is where NMSI comes into play. NMSI gives teachers the rigorous training and effective tools they need to succeed in the classroom. A K-12 system that does not emphasize instructional rigor will not adequately prepare students for the modern workforce or challenging college coursework.

We should not be afraid to challenge students—in fact, challenging students is the key to active student engagement. NMSI’s schools have been ranked as some of the most challenging in the U.S., and research has shown that students passing AP exams are three times more likely to earn a college degree than students who do not pass. Through the Comprehensive Advanced Placement Program, NMSI transforms high schools into centers of college- and career-readiness, and it has had a tremendous impact on African American and Hispanic students; in just one year of program participation, schools typically see a 200 percent increase in the number of students passing an AP exam.

Research indicates an AP course that culminates in an AP exam grade of three or greater has a significant, positive impact on a student’s likelihood of college success among academically comparable students. This is especially true for African American and Hispanic students, who have a 28 percent greater likelihood of college success when they take an AP exam compared to those who do not. Unfortunately, in 2012 only 27 percent of juniors and seniors nationally took AP exams (and only 13 percent of African American and 21 percent of Hispanic students did so). For math and science AP exams taken in 2012, the situation is even worse—only 10 percent of all juniors and seniors nationally, 4 percent of African American and 6 percent of Hispanic students took the tests. Dr. C. Kirabo Jackson, an assistant professor at the School of Education and Social Policy at Northwestern University, studied both the short- and long-term evaluations of NMSI’s work. His first study in 2007 found that NMSI’s Comprehensive AP Program not only produced significant increases in AP scores but also contributed to substantial increases in SAT/ACT scores and college matriculation, and that these effects continued to increase over time. From 1994-2005, Dr. Jackson’s study compared student cohorts at partner schools before and after the NMSI Comprehensive AP Program implementation. Comparing student outcomes from participants and non-participants of NMSI’s Comprehensive AP Program, Dr. Jackson found that participation in the NMSI AP program produced:

- A 22 percent average annual increase in AP exam qualifying scores (three or greater);
- A 30 percent increase in the number of students scoring at least 24/1100 on the ACT/SAT (on the 1600 scale); and
- An 8 percent increase in college matriculation.

Following the same student cohorts, Dr. Jackson’s second study in 2010 demonstrated that the increases in student achievement caused by NMSI’s Comprehensive AP Program persisted into college, with particularly positive effects on college outcomes for African American and Hispanic students:

- NMSI students were 22 percent more likely to persist in college than students not enrolled in the NMSI Comprehensive AP Program.
- African American students in the NMSI program were 69 percent more likely to graduate from a four-year college than African American students not participating in the NMSI program.
- Hispanic students in NMSI’s AP Program were 83 percent more likely to graduate from a four-year college than Hispanic students not in the program.

Fig. 1. Three Year Results—Percentage Increases in Qualifying Math/Science/English AP Scores

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<thead>
<tr>
<th></th>
<th>U.S.</th>
<th>NMSI</th>
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<tbody>
<tr>
<td>All Students</td>
<td>24%</td>
<td>137%</td>
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<tr>
<td>African American/Hispanic Students</td>
<td>50%</td>
<td>203%</td>
</tr>
<tr>
<td>Female Students</td>
<td>26%</td>
<td>167%</td>
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**Motivation**

As college graduation rates among minorities increase, underrepresented groups in STEM fields have more role models to inspire them. Strengthening the educational pipeline for minorities in STEM fields will have a huge impact on their motivation to study and work in those fields. Another big factor in determining a student’s motivation to increase academic achievement is the student’s capacity to complete rigorous coursework, a skill that can only be acquired through effective classroom experiences.

A recent report by the National Bureau of Economic Research found that students who are interested in a science major but not academically prepared for challenging classes often struggle in college science courses. Disappointed and discouraged, they opt out of their planned STEM majors for courses that may prove less difficult. Engaging various stakeholders such as parents and community members also helps construct a positive learning environment where students are motivated to succeed. With better preparation these students could thrive in a college setting, continuing with a major about which they are passionate—and for which America has a desperate need.

**Exposure to STEM Subjects**

Not only is early exposure to STEM subjects important, being surrounded by a community of STEM professionals is vital. Student participation in active research, hands-on experience and proven programs all increase student persistence and graduation in STEM majors. Creating the pipeline for the future STEM workforce is highly dependent upon effective STEM teachers. Recruiting the right people to become teachers and developing them into effective instructors are two of the most important factors in driving improved performance in schools. In its 2007 report, _How the World’s Best-Performing School Systems Come Out on Top_, McKinsey & Company studied 25 school systems across the globe to identify common attributes of high-performing schools. A key finding from the research showed that schools with the best teachers improve faster and perform more consistently. The President’s Council of Advisors on Science and Technology (PCAST) estimates that the U.S. will need more than 100,000 STEM teachers in 10 years. The PCAST also concluded that:

“To meet our needs for a STEM-capable citizenry, a STEM-proficient workforce, and future STEM experts, the nation must focus on two complementary goals: We must prepare all students, including girls and minorities who are under-represented in these fields, to be proficient in STEM subjects. And we must inspire all students to learn STEM and, in the process, motivate many of them to pursue STEM careers (page viii).”

The UTeach Program addresses this STEM crisis at a fundamental level, creating the next generation of math and science teachers with rigorous pedagogical training and deep understanding of STEM subject matter. UTeach provides students with intensive field experiences during the program and matches students with a mentor to help them master their coursework. Because of the sustained exposure and mentoring, 90 percent of students in the UTeach program go into teaching, and 80 percent of those teachers remain in their profession after five years (compared to retention rates of less than 50 percent for other teacher preparation programs).

**Summary and Call to Action**

In conjunction with more emphasis on STEM education at a young age, complementary activities outside of the classroom can increase student engagement in STEM fields. NMSI is a supporter of relevant and hands-on strategies for engaging students inside and outside of the classroom, and is proud to have an impact on student outcomes among minority groups in mathematics and other STEM subjects. With commitment and the proper tools, we can make an impact on all students and increase STEM talent in the U.S., including underrepresented minorities.

Now is the time to invest in the future of students and our STEM workforce. This investment can only be achieved by promoting measurable programs that promote STEM education and make STEM careers available to everyone. The success of NMSI’s programs and other STEM initiatives depend on robust funding mechanisms and streamlining of national STEM programs. NMSI favors a targeted approach for funding agencies and specific activities to ensure that available funding is used effectively to produce impactful results. In addition, NMSI supports a robust and balanced approach that will funnel resources to where the funds are needed most and to programs that have a proven impact and produce favorable results in schools.

**References**

General Session III
Scholarly Pursuits

Panelist
Vanessa Hill
Professor
Springfield Technical Community College

Education, then, beyond all other devices of human origin, is the great equalizer of the conditions of men—the balance-wheel of the social machinery. —Horace Mann

If they get these math tools then they will be in positions to demand access to the economic arrangements. These are the tools that are needed by people who are going to come to the table and act on their rights. —Bob Moses

Abstract
During this period of uncertain economic times and technological marketplace, community colleges have become an integral part of higher education. The mission of the community college, from inception, is to give an opportunity for further education to those who may not necessarily have access to private and four-year institutions. Increasingly, these students are under-prepared for college level work, 60 percent nationwide (NCES, 2004). Developmental education has become a cottage industry. Yet, students are not successfully navigating the system and attaining their goals. A major hurdle in their success is mathematics, specifically developmental mathematics. The consequence is that students are denied access to fields that are critical to our economy, such as engineering. This is not only a loss for the individual student, but also to industry as we become increasingly global, and diversity of thought is essential for progress.

Background and Problem
The burden of remedial education promises to increase as more and more four-year institutions are opting out of remedial education, leaving it to the community colleges (Boulard, 2004). The population of a community college has a much higher percentage of at-risk students than four-year colleges and universities. Thus, this failure to maneuver through the system, and attain educational goals perpetuates inequalities. The marginalized people of our society continue to be shut out of higher education; and the fallout of this trend can be felt throughout the country. Community colleges must therefore continue to fill the niche by providing opportunities to those who suffer disparities based on race, class and gender (Bahr, 2008). To add insult to injury it should be noted that nearly 75 percent of those students who begin in remediation classes never finish any college level mathematics (Bahr, 2008).

To compound matters students often enter into the developmental math classes and find the same type of curriculum and delivery that they experienced through their K-12 academic career (Desimone, Smith, Bauker & Ueno, 2005). This is the same curriculum that did not work for them at the outset, a skill based, lecture driven classroom that emphasizes performance of algorithms over the contextualization of the mathematics (McMillan, Park & Lanning, 1997, Grubb & Associates, 1999).

Even with all of the obstacles facing underprepared students and the alarming statistics of their lack of success and attrition, it must be noted that students who successfully remediate are equivalent to their peers who do not need remediation (Bahr, 2008). Therefore, remediation itself is not the problem, but effective remediation is more the issue at hand.

Promising Practices and Solutions
Ultimately, the teacher must have a robust understanding of mathematics in order to teach mathematics. It is imperative that they have the ability to look at and analyze a student’s work without comparing it to a particular solution that a textbook would illustrate. With that being said, there is so much more to bolstering student achievement than the mathematical knowledge of the teacher.

Instead of focusing on at-risk students, one perspective is to focus on at-risk courses (Phelps & Evans, 2006). At risk courses are those courses in which students have a high rate of failure. Using this premise, the student is no longer being singled out as the problem, or as somehow inferior, but the accountability is put on the course. One important thing to consider is the role of the teacher, in particular teacher immediacy. Albert Mehrabian first proposed the idea of immediacy. He created this principle based on his idea that “people are drawn toward persons and things they like, evaluate highly, and prefer; and they avoid or move away from things they dislike, evaluate negatively, or do not prefer” (Mehrabian, 1971, p.1). This is a weighty idea as examined in the context of teaching.

The idea of immediacy can be described as both verbal and nonverbal cues that lead to a perception of attachment between people (Richmond, Gorham & McCroskey, 1987). According to Christophel (1990) students who view their teachers with this type of immediacy view the course as well as the teacher with a more positive attitude. The implications of this positive environment are many and complex. For one student motivation is significantly increased. This is not to say that students necessarily develop an affinity for the course, but they are more willing to work at it, and develop a more positive attitude to the material.

Yet other things come in to play when addressing these at-risk courses. In
particular examining the structure of these courses as being conducive to positive learning environments. Some of the promising environments being explored are: problem-based learning, project-based learning, and cooperative learning.

We have had the opportunity to use these practices in some courses, with great success. Based on opportunities from NACME, ConnectEd, and our schools work with Achieving the Dream, we redesigned, and analyzed some courses to incorporate just these areas of focus. Our findings were very promising, and at times surprising. When we interviewed students and carried out focus groups after their experience, the number one theme that emerged was that the teacher mattered. This has been illustrated several times as administration stepped in and assigned classes to teachers who are not as invested and their results were more on par of a traditional classroom. This clearly ties back to the concept of teacher immediacy from the literature.

We were also very excited about the increases in both pass rates and retention rates among minority students, with pass rates approximately 18 percent higher and our retention rate was over 20 percent higher overall. It should be noted that we did not find the same results for majority students, which illustrated the one size fits all model does not work, and we need to offer multiple modes of introducing material if we are to reach all of our population.

**Summary and Call to Action**

Although the picture can be daunting, it is extremely important to note that there are things that can be done. We can make a difference and move the needle so that we have population parity in the STEM fields.

We can do this by promoting parity in funding. In my experience, I have found it a much easier sell to invest in the best and brightest, leaving those who need a bit of help to fend for themselves. Until we put the same amount of time and resources into those coming to us from a disadvantaged background, as we do those who are already far above and beyond, we cannot expect to see anything more than business as usual.

We can incorporate funding to train teachers in project and problem based learning. We can expand the contact hours so that time on task is increased, allowing a more conceptual understanding of mathematics, versus the mere rote memorization. Furthermore, we should adequately reward these individuals who are invested in the students, acknowledging that they are doing great work, and their efforts are not unappreciated.

We can and should be appalled that these students are seen as nothing more than the others, having no belief in their abilities or the unique and valuable experiences that they bring to the table. Until these students are seen as invaluable members of our community, that indeed our future is dependent upon, we are only hurting ourselves, and putting our own outlook in jeopardy.

References


A National Model for Engineering Mathematics Education: Uncorking the Bottleneck to URM Student Success

Abstract
This paper summarizes an NSF-funded initiative at Wright State University to address the nationwide problem of math-related attrition in engineering—a problem of particular importance to underrepresented minority (URM) students. The Wright State approach involves the development of EGR 101, a first-year engineering course replacing traditional math prerequisites for core sophomore engineering courses, along with a more just-in-time structuring of the required calculus sequence. Based on a recent longitudinal study, the approach has substantially mitigated the effect of incoming math preparation on student success in engineering across the entire range of incoming ACT math scores. While this has more than doubled the average graduation rate of enrolled students, it has nearly tripled the graduation rate of students from underrepresented groups (women and minorities). This has been accomplished without watering down the caliber of graduates, who have actually enjoyed a slight (but statistically significant) increase in graduation GPA. This call to action follows a recent NSF supplement for pilot adoption of the approach by three HBCU institutions, which could lay the groundwork for more widespread adoption by America’s minority serving institutions.

Background and Problem
It is well known that student success in engineering is highly dependent on student success in math, and perhaps more importantly, on the ability to connect the math to the engineering [1-6]. However, first-year students typically arrive at the university with virtually no understanding of how their pre-college math background relates to their chosen degree programs, let alone their future careers. And despite the national call to increase the number of graduates in engineering and other STEM disciplines [7], the inability of incoming students to successfully advance past the traditional freshman calculus sequence remains a primary cause of attrition in engineering programs across the country. This is of particular importance for URM’s, whose degree attainment in engineering continues to lag that of the general population [8-9]. As such, there is a drastic need for a proven model, which eliminates the first-year mathematics bottleneck in the traditional engineering curriculum, yet can be readily adopted by engineering programs across the country. Such is the focus of this work.

Promising Practices and Solutions—The Wright State Model
The Wright State approach begins with the development of a novel first-year engineering mathematics course, EGR 101 “Introductory Mathematics for Engineering Applications.” Taught by engineering faculty, the course includes lecture, laboratory and recitation components. The EGR 101 lecture sections are completely driven by problem-based learning, while the laboratory and recitation sections offer extensive collaborative learning among the students. As such, the course is strongly supported by the literature on how students learn [10-14]. Using an application-oriented, hands-on approach, the course addresses only the salient math topics actually used in core engineering courses. These include the traditional physics, engineering mechanics, electric circuits and computer programming sequences. Most importantly, the EGR 101 course replaces traditional math prerequisite requirements for the above core courses, so that students can advance in the engineering curriculum without first completing the required calculus sequence. The Wright State model concludes with a more just-in-time structuring of the required math sequence, in concert with college and ABET requirements. The result has shifted the traditional emphasis on math prerequisite requirements to an emphasis on engineering motivation for math.

The Wright State model was first implemented in Fall of 2004, and its effect on student retention, motivation and success in engineering has since been widely reported [15-27]. The 2007 introduction of EGR 100/199 as a precursor to EGR 101 for initially underprepared students has further strengthened the approach, and has made the core engineering curriculum almost immediately accessible even to incoming students placing as many as three classes behind the first required calculus course.

The longitudinal impact of EGR 101 on graduation rates in Wright State’s College of Engineering and Computer Science has substantially mitigated the effect of incoming ACT math scores. While this has more than doubled the average graduation rate of enrolled students, it has nearly tripled the graduation rate of students from underrepresented groups (women and minorities). This has been accomplished without watering down the caliber of graduates, who have actually enjoyed a slight (but statistically significant) increase in graduation GPA. This call to action follows a recent NSF supplement for pilot adoption of the approach by three HBCU institutions, which could lay the groundwork for more widespread adoption by America’s minority serving institutions.

Panelist
Nathan Klingbeil, Ph.D.
Associate Dean for Academic Affairs
College of Engineering and Computer Science
Professor of Mechanical and Materials Engineering
Wright State University

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It is well known that student success in engineering is highly dependent on student success in math, and perhaps more importantly, on the ability to connect the math to the engineering [1-6]. However, first-year students typically arrive at the university with virtually no understanding of how their pre-college math background relates to their chosen degree programs, let alone their future careers. And despite the national call to increase the number of graduates in engineering and other STEM disciplines [7], the inability of incoming students to successfully advance past the traditional freshman calculus sequence remains a primary cause of attrition in engineering programs across the country. This is of particular importance for URM’s, whose degree attainment in engineering continues to lag that of the general population [8-9]. As such, there is a drastic need for a proven model, which eliminates the first-year mathematics bottleneck in the traditional engineering curriculum, yet can be readily adopted by engineering programs across the country. Such is the focus of this work.

Promising Practices and Solutions—The Wright State Model
The Wright State approach begins with the development of a novel first-year engineering mathematics course, EGR 101 “Introductory Mathematics for Engineering Applications.” Taught by engineering faculty, the course includes lecture, laboratory and recitation components. The EGR 101 lecture sections are completely driven by problem-based learning, while the laboratory and recitation sections offer extensive collaborative learning among the students. As such, the course is strongly supported by the literature on how students learn [10-14]. Using an application-oriented, hands-on approach, the course addresses only the salient math topics actually used in core engineering courses. These include the traditional physics, engineering mechanics, electric circuits and computer programming sequences. Most importantly, the EGR 101 course replaces traditional math prerequisite requirements for the above core courses, so that students can advance in the engineering curriculum without first completing the required calculus sequence. The Wright State model concludes with a more just-in-time structuring of the required math sequence, in concert with college and ABET requirements. The result has shifted the traditional emphasis on math prerequisite requirements to an emphasis on engineering motivation for math.

The Wright State model was first implemented in Fall of 2004, and its effect on student retention, motivation and success in engineering has since been widely reported [15-27]. The 2007 introduction of EGR 100/199 as a precursor to EGR 101 for initially underprepared students has further strengthened the approach, and has made the core engineering curriculum almost immediately accessible even to incoming students placing as many as three classes behind the first required calculus course.

The longitudinal impact of EGR 101 on graduation rates in Wright State’s College of Engineering and Computer Science has substantially mitigated the effect of incoming ACT math scores. While this has more than doubled the average graduation rate of enrolled students, it has nearly tripled the graduation rate of students from underrepresented groups (women and minorities). This has been accomplished without watering down the caliber of graduates, who have actually enjoyed a slight (but statistically significant) increase in graduation GPA. This call to action follows a recent NSF supplement for pilot adoption of the approach by three HBCU institutions, which could lay the groundwork for more widespread adoption by America’s minority serving institutions.
The introduction of EGR 101 and associated prerequisite changes have effectively mitigated the impact of incoming math preparation on student success in engineering over the full range of incoming ACT math scores. Clearly, the Wright State approach has made engineering accessible to an extremely broad range of American high school graduates. That said, a legitimate concern with increasing the accessibility of the curriculum is whether it waters down the caliber of engineering graduates. As shown in Figure 3, this seems not to be the case. On the contrary, students who took EGR 101 enjoyed a slight (but statistically significant) increase in graduation GPA. That strongest effect was for members of underrepresented groups, for whom taking EGR 101 was the difference between graduating with a 2.9 or graduating with a 3.0—the interview cutoff for many prospective employers.

**Summary and Call to Action**

The President’s Council on Jobs and Competitiveness has issued a call for
10,000 more engineers per year, or roughly a 14 percent increase in the national production of engineering graduates [28]. Based on the data presented herein, the Wright State model has the potential to double the graduation rate of engineering students at open access institutions, with an even greater impact on members of underrepresented groups. As part of our NSF STEP Type 1 and CCLI Phase 3 initiatives, various aspects of the approach are now being piloted by dozens of institutions across the country (primarily university, but also at the community college and K-12 levels). The recent publication of our nationally marketed textbook [29] is intended to encourage an even more widespread adoption of the approach. A recent TUES Type 3 supplement has added three HBCU institutions to the project team. These include Howard University, Morgan State University and the University of Maryland Eastern Shore. If successful, the pilot adoptions by these three institutions will lay the foundation for more widespread adoption across the HBCU’s and other minority serving institutions, which could ultimately have a significant impact on America’s production of URM engineers.

Acknowledgment
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References


2013 NACME National Symposium
General Session IV
Innovations in STEM Teaching and Learning

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National Action Council for Minorities in Engineering, Inc. (NACME)

Plenary Speaker
Jacqueline Fleming, Ph.D.
Independent Researcher
Innovations in STEM Teaching and Learning

Panelist
Etta Hollins, Ph.D.
Professor and Kauffman Endowed Chair for Urban Teacher Education
University of Missouri, Kansas City
Culture as Context and Text

Panelist
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Temple University College of Engineering
Making the Case for Culture, Cognition, and STEM Learning

Panelist
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That None Shall Perish
General Session IV
Innovations in STEM Teaching and Learning

Plenary Speaker
Jacqueline Fleming, Ph.D.
Independent Researcher

Abstract
To encourage URMs to enter STEM fields and further to encourage American students to enter STEM fields, they must become enamored of science. Instruction is the key to this process. But the way we teach students is changing, and much of this change is driven by students themselves. They are no longer content to sit and listen to long lectures, but require involvement in the learning process. New methods include the design of interactive classrooms with a new appreciation for the Socratic method, hands-on problem-based learning, and the infusing of culturally relevant content. Cutting edge methods include subliminal messages in audio media or embedded in PowerPoint slides, as well as subliminal prompts in human-computer interaction. These innovations in teaching have implications for learning outside the classroom and even on the battlefield. For the engineering pipeline, the methods that produce enhanced learning also produce equal or better learning for underrepresented minorities. Since most innovations in teaching are faculty driven and classroom based, the encouragement of faculty innovation should be a priority for policy makers.

Background and Problem
The way we teach students is changing. The way students learn is changing. But what is driving this change and what do these changes imply for URMs in STEM fields? This review takes a brief look at evidence-based innovations in instruction that affect learning—all the way from basic interactive classrooms to predictions of a bookless University. Then we ask how can policy makers support and encourage these changes? The good news in this conversation is that innovations in teaching benefit URMs as much or more than other students. Marc Prensky, educator and developer of game-based learning is perhaps best known for describing today’s students as digital natives, that is those who were born to the digital media of computers, video games, iPads, texting, and social networking (Prensky, 2001, 2010, 2012). He argues, based on a reading of scientific evidence, that the brains of students today (the digital natives) are physically different, hardwired differently if you will. The brain is plastic or neuroplastic and is capable of reorganizing but only with sharply focused attention spanning sustained hours over a sustained period of time—just the kind of sharply focused attention that students spend in video games, online, texting, and social networking. Thus their brains have adjusted to speed, interactivity, attentional deployment or multi-tasking, fast rewards and have developed hypertext minds, capacity for jumping around due to the development of parallel versus sequential cognitive structures. The result is that the educational system was designed for students who no longer exist. And yes, digital natives have short attention spans—for the old ways of sequential learning—but not for digital media. Prensky describes the instructors as digital “immigrants”—those not well versed in the digital language of today—who have difficulty understanding and teaching the digital natives. Teaching requires recognition and it is not students who need to be fixed. It is instructors who must adapt to students if they want to keep their attention. The studies that we review here were conducted either on URMs, URMs in math, science and engineering, or on engineering students in general. A number come from research in my former shop at Texas Southern University (TSU).

Promising Practices
Interactive Classrooms
Interactive procedures are becoming standard in classrooms of a permissible size. Interactive methods are exemplified by the Socratic Method, well known in law school. Despite its being higher venerated, there isn’t much research on it. I was charged with designing exemplary classrooms for incoming developmental students at historically black Texas Southern University (Fleming, 2012). To do this our instructors were required to use the Socratic Method along with a number of interactive procedures. This was not easy to do because it requires a great deal of different preparation by instructors. They had to be monitored carefully over time or they would revert to type. Students were also assessed frequently to determine the extent to which they perceive the classroom as interactive. The effect was a more satisfying classroom experience for students. They thought more of their teacher’s effectiveness. They liked the courses more. Their instructors rated them as working harder, and higher course grades often occurred. However, perceiving the classroom as interactive was unrelated to their standardized test scores, i.e., to their tested ability. This suggests that the Socratic Method is a method of democratically distributing an instructor’s attention to all students, not just those bright enough to engage the instructor. So, not only does the instructor need the student’s attention, but students also need the instructors attention for optimal learning to take place.

Classes That Click
Designing an interactive classroom is not feasible for all classrooms, especially large lecture classes typical of freshmen science courses. Yet elements of them can...
be adapted to the large class. Frequent testing is an example. While students almost unanimously prefer less testing, rest assured that frequent tests will keep students awake and attentive. Student Response Systems, better known as clickers, provide just such rapid immediate feedback to questions or quizzes embed throughout a lecture. Each student is given a hand-held device for communicating or clicking answers so that the instructor knows whether students are following the material. Researchers at California Polytechnic State University and Rowan University (Chen, Whittinghill & Kadlowec, 2010) found that in a two-year study that students performed better in core engineering classes, such as statistics with the immediate feedback provided by clickers. A review of these studies (e.g., Bruff, 2009) found that the use of clickers improved students test performance an average of 11 percent across all studies.

Social Networking
Students would rather network socially than listen to a good lecture. If there is a lull in the lecture, they will whip out their phones, iPads and computers and get on Facebook while pretending to take notes. So, can this inclination to social networking be harnessed to enhance learning? Working on a Faculty Action Research grant at Texas Southern University, Kimberly McLeod developed a website called TheBookstart.com. Its purpose was to increase interaction among readers and to link readers with authors. In several graduate classes, 113 students were randomly assigned to post their reading assignments on TheBookstart.com, where they could interactively discuss the assignments with other students, or on Blackboard, which does not permit interaction among students (McLeod & Price, 2010). The authors found that students using the academic social networking site began their assignments significantly earlier, contributed significantly more postings. Their course grades were higher although their pass rates were not significantly higher (See Figure 1).

Experimental Curricula in Engineering
Engineers are problem solvers. Thus, any instruction that engages this inclination has great promise. Richard Felder, Michael Prince and their colleagues have designed an experimental engineering curriculum with multiple approaches to problem solving (Felder & Brent, 2004; Prince & Felder, 2006). They have found that engineering school favors introverts, but their experimental curriculum enables all students to be taught by methods that appeal to their personality type at least part of the time so that education is not so uncomfortable for them. Their experimental curriculum includes inquiry learning, problem-based learning, project-based learning, case-based learning and just in time teaching. What I find as interesting as their methods is their reasoning. They say that traditional engineering instruction is deductive, that is, beginning with theories and progressing to the application of those theories. This approach favors students with an inclination to the abstract. This approach typically does not favor minority students. Much has been written about this by Hale-Benson (1986) and others on the distinction between splitters and lumpers. According to the positivist model that has dominated higher education for centuries, absolute knowledge or objective reality exist independently of human perception. The teacher’s job is to transmit this knowledge to students. Lecture is the natural method of doing so. The student’s job is to absorb it. In the alternative model, constructivism, objective reality aside, individuals actively construct and reconstruct their own reality in order to make their experience (Mestre, 1989; Yazdani, 2006). Mestre (1989) has found that individuals have surprisingly well developed theories about natural phenomena that they give up only reluctantly. New information is filtered through their prior mental structures. If new information is consistent with prior schemas, it is likely to be integrated and retained. However, if it is inconsistent, it may be memorized but then discarded. To the extent that individuals actively participate in the construction of their knowledge and experiences, the possibilities for integration and retaining knowledge are improved. What these methods have in common is that they are learner-centered, involve students discussing questions and solving problems, with much of the work being done in cooperative groups. They usually involve real phenomena. The most dramatic finding from this experimental curriculum is that 80 percent of the extroverts who began it, graduated after five years, whereas they were at a disadvantage in all prior studies by these authors.

Cultural Relevance in Mathematics
Most mathematics instructors think cultural relevance is irrelevant. Yet, I did manage to convince several of them at Texas Southern to experiment. Our approach was to change the content, that is, the back story, of standard word problems. A series of 20 math word problems, each with standard and relevant versions, were developed on percentages, reading data from graphs, fractions, word problems and algebra. Similar, parallel versions of each math problem were developed. Culturally relevant scenarios were created using census data, TSU student data, as well as historical data from sources such as the civil rights movement to create the math word problem. The thing to note in the B versions shown in Table 1 is that only the words “African American” or a reference to a historically black college constituted cultural relevance. In the first study, when students were given a multicultural pretest, midterm and posttest with both standard and relevant items embedded, performance on the relevant items of these tests were always significantly higher (Guo & Fleming, 2012; See Figure 2).

Subliminal Priming and Human Computer Interaction
Contrary to the 1950’s when subliminal perception was associated with controversy, it has now become a legitimate academic enterprise with implications for academic instruction. Priming involves the temporary activation of constructive cognitive representations outside of awareness (Bargh, 2006). A wide range of behaviors have been influenced by subliminal priming, including academic performance. (Lowery, Eisenberger, Hardin & Sinclair, 2007). Priming of subliminals has found its way into the field of human computer interaction (HCI). Chalfoun & Frasson (2008) investigated the use of subliminal cues while teaching using an HCI tutoring technique for enhanced learning. Subliminal visual cues depicting correct answers to a magic square problem projected onto the computer screen improved learners’ inductive reasoning ability, which facilitates the retention of knowledge. If you think subliminal learning is outlandish, know that priming has
far reaching applications including use in military operations. In this research, the conversation is about the extent to which subliminal priming might interfere with the combat mission (DeVaul & Pentland, 2002; DeVaul, Pentland & Corey, 2003).

**Subliminal Self Help Audio Tapes**

HCI raises the subject of subliminal self help as in audiotapes or CDs. A study of minority students over three years who finished an eight-week summer at Texas Southern, investigated the utility of using commercial subliminal audio aids to improve academic performance, along with a method of automatic delivery of said messages (Fleming, Forthcoming). Participants in the experimental group were asked to use the subliminal audio aid for “Accelerated Learning” with a CD alarm clock as a morning alarm. The study, however, found that all participation was not equal. When students were separated on the basis of who continued communication with staff and who did not, fully participating students showed a significant 35 percent to 40 percent improvement on ten of the fourteen measures of academic performance compared to the control group (See Figure 3). The strongest effects were found for the critical subjects of math and science.

**Summary and Call to Action**

From the point of view of underrepresented minorities in engineering, the new directions in higher educations are promising because URMs benefit as much or more than majority students in classrooms employing them. Those innovations cited above include interactive classrooms with the Socratic method, clickers, social networking via TheBookstart.com, the problem-solving curriculum in engineering, cultural relevance, and subliminal priming. These and other innovations in teaching are not necessarily wide-spread. Most innovations are faculty driven. Yet many faculty do not innovate unless they are required to or have incentives for doing so. To the extent that we can turn the complaints that faculty now have about how students are different into teaching innovations that harness the differences and capture their attentions, so much the better. To the extent that policy can encourage greater replication of innovations and support faculty innovation to ensure a wider field of new ideas.

**References**


Fleming, J. (Forthcoming). Can You Lead a Horse to Water and Make Him Drink?: The Utility of Subliminal Audio Messages for At-Risk Minority Students. Unpublished manuscript.


Figure 1.

Table 1.

<table>
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<td>0.78</td>
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Figure 2
Performance on Standard and Culturally Relevant Items Embedded in Classroom Tests

Source: Guo & Fleming, 2012

Figure 3
Subliminal Learning Project: Fall and Spring Academic Performance for Non-Project, Project without Update, and Project with Update Students

Source: Fleming, Forthcoming
General Session IV
Culture as Context and Text

Panelist
Etta Hollins, Ph.D.
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The education of underrepresented and underserved students is a long-term and persistent challenge for public schools (National Center for Educational Statistics, 2011, 2012). Several different ways of explaining this challenge have emerged, including genetic inferiority, cultural deficit, cultural mismatch, and contextual interaction (Hollins, 2008). Each of these perspectives has proposed a possible solution to the challenge. However, none of the proposed solutions based on these perspectives have brought about the desired long-term systemic change for improving academic learning outcomes for underrepresented and underserved students. More recent propositions for addressing the challenge of education for underserved students have focused on social justice education, socially just pedagogy, and the relationship between culture and cognition.

Over the past several decades, multicultural education has been an important influence on education at all levels. The initial focus of multicultural education was on equitable access to opportunities for learning and employing education as a tool for social change advancing social justice for all citizens. Access to opportunities for learning referred to expanding the curriculum to include the culture and history of the diverse groups that comprise the population of the United States and adjusting pedagogy to include the experiences and values of underserved students. Banks (1989) described different approaches to multicultural education that included: the contribution approach celebrating heroes and holidays, adding themes and perspectives to the curriculum without changing the structure, transforming the curriculum perspective and structure, and student participation in social action for social change.

In later work, Banks (1993, 2006, & 2007) identified five dimensions of multicultural education—content integration, knowledge construction, equity pedagogy, prejudice reduction, and an empowering school culture and social structure. The central principles, practices, and purpose of multicultural education are to some extent implanted in the curriculum and pedagogy of schooling; however, while multicultural education has served to improve the conditions of schooling, it has not had the intended impact on student learning outcomes.

Many of the proponents of multicultural education have had experience as practitioners in school settings. This has supported a focus on classroom and school practices. However, researchers from other perspectives have participated in discussions and investigations of the influences on and outcomes of school practices. Nasir & Hand (2006) provided an overview of sociocultural perspectives on race, culture, and learning. In the first part of the discussion, these authors point out the different explanations for differences in learning outcomes for ethnic minority students when compared to their white peers. Many such explanations have focused on macro-societal factors such as social and economic conditions, and the race and social class status of the learners. Some early scholars located the problem with the learners who were blamed for being underprepared or not having the social capital necessary to fully benefit from the schooling process. More recent scholars have located the problem in the inflexibility of school practices that are based on majority cultural values and practices that do not provide equitable access for underserved and underrepresented groups. Scholars employing a sociocultural perspective have located the problem in a more complex understanding of culture and the relationship between culture and learning. According to Nasir & Hand (2006), a “…core principle of sociocultural theories of learning and development is the idea that the cultural tools and artifacts that people encounter as they participate in the activities of daily life are critical to the nature of the learning and development that arises” (p. 461).

The challenge confronting practitioners is that of translating theoretical explanations for the relationship between culture and learning into a format for making decisions about everyday classroom and school practices. The concept of cultural congruence in instruction is intended to address this challenge. The central argument in this paper is that using culture as context, and as text in particular situations, facilitates the development of deep knowing for traditionally underserved students in elementary and secondary schools. Deep knowing is characterized by the capacity for discerning, interpreting, translating, applying, and responding appropriately. Deep knowing is based on repeated and affirming contextualized experiences and observations providing insight that informs and enables full participation in social activity, including classroom learning. Cultural congruence in instruction is an approach to teaching that makes learning accessible by building upon and extending cultural ways of knowing to support academic knowledge and practices. In essence, this approach requires the use of cultural tools and artifacts students encounter in the activities of daily life.

This argument is grounded in E.T. Hall’s (1977) conceptualization of culture as
“man’s medium,” (p. 16) and the idea that cultural congruence in instruction is essential for learning and deep knowing. In this discussion, culture is cognition—a way of knowing, being, and responding to the world. Cultural congruence refers to the location of learning experiences, procedures, processes, and learning tasks within the cultural ways of knowing, experiences, practices and values of the learner. The process of facilitating deep knowing of academic subject matter and skills for many underserved students requires: (1) bringing attention to specific qualities of a particular everyday practice, (2) developing a more complex understanding of a familiar practice or experience, (3) learning to transfer knowledge or to apply a skill in a different context or for a different purpose, and/or (4) using particular cultural tools or experiences as a bridge for learning new academic subject matter or skills. This approach strengthens and brings to the conscious level knowledge of the familiar as a scaffold for related learning and skill development. One example of this approach is Lee’s (1995) use of “signifying,” an example figurative language in African American culture, to support African American students’ understanding of figurative language used in complex literary text. In this situation language was context, text, and a tool for deciphering complex literary text using a familiar language function. This strategy made the unfamiliar more familiar by building upon and extending knowledge of everyday language usage.

Using everyday language to develop understanding of new concepts and principles before translating to academic or discipline specific language is another approach to developing deep knowing. Brown & Ryoo (2008) reported using this approach in a research study in teaching science to minority students in an urban elementary school. In this study one group of students was assigned to a computer-based lesson on photosynthesis using their everyday language where scientific language was introduced after developing a basic understanding of concepts. The second group was assigned to a computer-based lesson on photosynthesis using scientific language throughout. The results showed that students who were introduced to scientific concepts using their everyday language first performed better than those assigned to the lesson that used scientific language throughout.

A third approach to developing deep knowing is by engaging students in contextualized experiences and learning tasks. Moses and colleagues (1989) engaged students in a five-step learning process in teaching algebra that began with participating in a familiar event such as cooking or riding a commuter train to understand the concept of equivalents. The students constructed a model or picture of this event. Students described the event using their everyday language. They developed a description of the event using academic language. Finally, students developed a symbolic representation of the event. In this situation giving attention to a familiar experience in a different way allow the familiar to become the context and a tool for learning a new concept or skill.

Deconstructing the learning experiences presented in the examples above reveals the nexus of culture and classroom learning—the core of cultural congruence in instruction. At the nexus of cultural and classroom learning are five interconnected elements: (a) the particular component of culture such as language or cultural practices within which new knowledge or skill will be located; (b) the specific function—experience, practice, or value within the cultural component that will serve as the context or text for scaffolding learning; (c) the factor or particular aspect within the function that when incorporated into the approach will support new learning; and (d) the approach—learning experiences, procedures, processes, and learning tasks, including the theoretical understanding that facilitates new learning.

In the first example, Lee (1995) the cultural component is language. The specific function of language used was representational or figurative. The factor is the interpretation and use of figurative language. The approach used in the learning experience was analyzing the use of figurative language in everyday discourse among peers as a basis for transferring this knowledge to deciphering complex literary text.

In the second example, Brown & Ryoo (2008), the cultural component used is language. The function of language used was conceptual understanding. The factor is the translation of conceptual understanding from everyday language to the academic language of science. The approach was the use of everyday language to document observations, develop generalizations, describe procedures, and explain concepts prior to translating to scientific language.

In the third example, Moses et al. combine language and shared experience as the cultural component. The function is conceptual understanding. The factor is representation, interpretation and translation. The approach used was engaging students in everyday experiences as the physical representation of mathematical concepts, interpreting the representation as concepts expressed in everyday language, and finally, translating everyday discourse into the language of mathematics.

Evidence from the researched examples discussed in this paper and others indicate that teaching practices located at the nexus of culture and learning provide underserved students with more meaningful opportunities for learning than traditional approaches. This means that teachers need to be able to identify the particular cultural component, the function of the cultural component that will provide the context for learning, the factor within the function that will form the basis for the approach that will be used, and an approach that brings together these elements and the subject matter or skills to be learned. Teaching at the nexus of culture and learning holds significant promise for improving academic performance for presently underserved students, and for increasing the number of those in the pipeline for STEM related careers.

References


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General Session IV
Making the Case for Culture, Cognition, and STEM Learning

Panelist
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Director of STEM Education, Outreach & Research
Founding Director, Pennsylvania MESA
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Introducing STEM education to underrepresented minority (URM) students is both a national mandate and a national challenge. STEM professionals represent 5.3 percent of the U.S. workforce, but the combined economic output from these fields contributes to at least 50 percent of the nation’s GDP, and 85 percent of measured growth in the U.S. income per capita.

For the past eight years, compelling reports from the National Academies have advised that continued failure to produce American born STEM talent is a threat to American global competitiveness. The most recent report, “Expanding Underrepresented Minority Participation: America’s Science and Technology Talent at the Crossroads” (NRC, 2010) outlines the clear and urgent need to tap all of the nation’s talent, including developing and retaining American students of color in STEM fields.

However, the failure to sufficiently engage and motivate minority students to persist in math and science hinders broader participation in STEM careers. One assumed correlation is that simply offering out of school/afterschool STEM activities will inspire disadvantaged students to become interested in graduating from high school, then majoring in engineering and science. That model has not worked. However, there is room for optimism if we shift our approach to achieve meaningful STEM diversity.

First, Learning STEM is not Culture Neutral
Social psychologist Richard Nisbett suggests that differences in socialization influence how the mind receives information to make choices and decisions. We see examples of how this works when we consider cognition and STEM3. Psychologist and cognitive neuroscientist Stanislas Dehaene’s research indicates that the language of Asian students allows for easier memorization and easier recall in math4. The memory gap between Western and Asian children is exacerbated by the fact that American language for counting is more complicated that many Asian languages.

Thus, the case can be made that their culture cognitively advantages Asian children in math. They have an organic advantage for information processing built into their culture.

The fact that Asian social culture also promotes academic achievement as part of the national identity creates very fertile ground for many Asian children to do well—not because they are biogenetically “built” to be better, but because their culture has natural assets to make their learning easier.

Dr. A. Wade Boykin’s empirical research suggests African American children show higher math achievement in learning environments that incorporate their cultural orientation toward small group learning and high-energy exchanges of information5. Thus, early K-12 STEM learning can be advanced for cultural and linguistic minorities by identifying and leveraging socially normed behavior modalities to their benefit.

The research challenge is to establish a culturally derived basis for examining which variable (or combination of variables) is more likely to influence minority student engagement. A review of literature suggests that evaluating the symptoms of student disengagement (whether they get involved) ignores how children of color are socialized to be. Rethinking conventional wisdom about pedagogy to incorporate the social reality of how children experience learning while living is at the heart of culture and cognition research.

Second, Motivation to Persist in STEM Requires Broad Exposure
Many programs offer minority students a very limited selection of STEM activities in which to participate, and of those, we often see a single point of entry6. For example when they can afford it schools may offer robotics, but there is insufficient information about how medicine, technology, IT and other “hard science” disciplines can improve quality of life in urban settings, something of significant interest to inner city children. Diversifying the opportunities to learn is critical for engaging, refining and helping channel students’ passion toward appropriate STEM domains.

Third, Learning STEM May Improve With Increased “Identity Affinity”
Many “underrepresented minorities” do not have a strong history and inheritance of academic or career achievement in STEM fields in their immediate families. It is my contention that 21st century learners with the potential to accelerate are least likely to have opportunities for “early identity affinity.”

The history of denied access to and/or underperformance in the gatekeeper courses like algebra, calculus, and science has yielded few examples of Black, Latino, and Native American success that students can point to as role models for advancing in STEM careers. This is a truly significant
issue. Emerging evidence suggests that students’ level of engagement and motivation to persist is directly tied to their sense of belonging and membership in these more challenging fields.

The good news is that introducing an integrated framework of social culture, classroom culture and expert culture in a culturally aligned pedagogy allows us to address serious structural barriers to learning for minority students:

- In the U.S., only 30 percent of physics and chemistry teachers and barely 50 percent of math teachers are even certified to teach their subjects. It is worse in large, heavily “minority” urban districts that have fewer funds to pay qualified teachers to stay, offering fewer opportunities to learn in rigorous STEM classes. (National Center for Education Statistics)

- There is a fundamental need for solid evidence that participating in STEM enrichment activities results in minority high school students actually taking more rigorous coursework, graduating and matriculating in STEM fields when they enter college.

- Given current economic challenges, continued investment in STEM education innovation will likely target those programs that directly respond to global workforce priorities including accelerating cognition in blue collar and white collar STEM careers.

- Taking the prevailing environmental issues into consideration, my team has tested a number of STEM related programs using three core elements: communal team learning, a cognitive apprenticeship framework (intergenerational expert-novice transfer of knowledge), and rigorous skill development. There are two abbreviated examples of programs designed to use an existing STEM program framework (the Mathematics, Engineering & Science Achievement (MESA) model), but flexing it to incorporate socially and culturally relevant content.

The hypothesis was that providing a culturally enriched learning environment would yield measurable improvement in cognition and identity affinity in the target domains. Culturally and socially relevant learning elements included communal group learning, intergenerational transfers of learning, Socratic “call and response,” expectation of high achievement and strong interaction with technology. In education, there are two types of “knowing.” One type is called a declarative fact—standard, foundational facts we learn in school or from a structured learning context. An example would be the research done on minority community health. A second type of “knowing” is referred to as procedural knowledge. This describes those pieces of information we learn while performing a task, including “how to” strategies we learn from experts in the field. In addition to declarative and procedural knowledge, our research goal has been to measure “identity affinity” after exposure to a variety of STEM opportunities to learn.

The following examples depict outcomes of a cognitive apprenticeship immersion model for the same group of underrepresented minority students enrolled in two separate programs, the first a two-week biomedical summer camp (40 hours), followed immediately by a fall 20-week engineering Saturday Academy (60 hours). The participants were primarily African American, middle school boys from low-income households. Subject matter experts were Navy medical officers and Navy civilian engineers.

- 40 students:
  - 92.5 percent African American,
  - 5 percent East Indian,
  - 2.5 percent Hispanic

- Gender:
  - 70 percent males, 30 percent females

- Grade levels:
  - 2.5 percent elementary, 85 percent middle schools, 12.5 percent high school

### Table 1. Percentage Change in Medical Health Knowledge

<table>
<thead>
<tr>
<th>Sample items to assess change in knowledge (Declarative – facts we learn in school &amp; Procedural – “how to” job related facts)</th>
<th>Pre-Test % Correct</th>
<th>Post-Test % Correct</th>
<th>% Change</th>
</tr>
</thead>
<tbody>
<tr>
<td>(D) Ben Carson (b. 1951) is a world famous African American doctor in what field?</td>
<td>53.6%</td>
<td>83.3%</td>
<td>29.7%</td>
</tr>
<tr>
<td>(D) The first open heart surgery in the U.S. was performed by which African American doctor?</td>
<td>25.9%</td>
<td>36.7%</td>
<td>10.8%</td>
</tr>
<tr>
<td>(P) Why is it important for doctors to be able to relate to their patients?</td>
<td>50.0%</td>
<td>48.0%</td>
<td>-2.0%</td>
</tr>
<tr>
<td>(P) How many years of math should you take in high school to get ready for college?</td>
<td>81.0%</td>
<td>81.0%</td>
<td>0.0%</td>
</tr>
<tr>
<td>(P) Why is nutrition important to monitoring patient health?</td>
<td>68.0%</td>
<td>51.7%</td>
<td>-16.3%</td>
</tr>
<tr>
<td>(P) Which of the following are surgical instruments you used?</td>
<td>22.2%</td>
<td>29.0%</td>
<td>6.8%</td>
</tr>
<tr>
<td>(P) The best way to use surgical instruments is to use…</td>
<td>21.4%</td>
<td>71.0%</td>
<td>49.6%</td>
</tr>
<tr>
<td>(P) What is the best answer about laparoscopic surgery?</td>
<td>16.7%</td>
<td>23.3%</td>
<td>6.6%</td>
</tr>
<tr>
<td>(D) Why is the patient simulator so important</td>
<td>73.1%</td>
<td>74.2%</td>
<td>1.1%</td>
</tr>
<tr>
<td>(P) Intubations are done by…</td>
<td>44.0%</td>
<td>54.8%</td>
<td>10.8%</td>
</tr>
</tbody>
</table>
Table 2: Sample Changes in Cognition Across the 20-Week Engines Design Program

In general the student responses were stable or trended upwards. This is not surprising given the students’ initial motivation to learn. The majority of items sampled were declarative, related to understanding key concepts about how engines work. The types of questions reflected the heavy lecture orientation, with some hands-on procedural skill building opportunities used to supplement the content.

The stability in the responses two weeks after the program ended suggests knowledge retention may be associated with immersion in an engineering environment that provided “in the moment” expertise, opportunities to practice and apply new knowledge, appropriate scaffolding and high expectations for success.

Very similar (and compelling outcomes) are emerging in computer science, robotics, bio-engineering and mobile apps programs for middle and high school students. Students engaged for less than two-years in these programs have won national awards, recognition and cash prizes verifying the value of participation.

<table>
<thead>
<tr>
<th>Sample items to assess change in knowledge (Declarative – facts we learn in school &amp; Procedural – “how to” job related facts)</th>
<th>Pre-Test % Correct</th>
<th>Interim-Test % Correct</th>
<th>Post-Test % Correct</th>
</tr>
</thead>
<tbody>
<tr>
<td>(D) What is the difference between a fuel for an auto and fuel for a navy engine?</td>
<td>60%</td>
<td>89%</td>
<td>100%</td>
</tr>
<tr>
<td>(D) Name several (2 or more) tools used to work with engines</td>
<td>68%</td>
<td>62%</td>
<td>92%</td>
</tr>
<tr>
<td>(P) What is CAD/Solid-works used for?</td>
<td>9%</td>
<td>100%</td>
<td>100%</td>
</tr>
<tr>
<td>(D) Circuitry is important in engines systems because</td>
<td>60%</td>
<td>73%</td>
<td>75%</td>
</tr>
<tr>
<td>(D/P) What type of engineering would you study to work with engines (multiple answers allowed)</td>
<td>86% ME, 41% EE, 13% any</td>
<td>93% ME, 48% EE, 13% any</td>
<td>85% ME, 48% EE, 25% any</td>
</tr>
<tr>
<td>(D) What is the purpose of the waste gate in turbo charged engine systems?</td>
<td>--</td>
<td>33%</td>
<td>67%</td>
</tr>
<tr>
<td>(D) Difference between single grade and multi grade engine oil?</td>
<td>--</td>
<td>80%</td>
<td>86%</td>
</tr>
<tr>
<td>(P) If a steam engine uses a pump, boiler and turbine, explain in detail and draw the 4th process?</td>
<td>--</td>
<td>60%</td>
<td>64%</td>
</tr>
<tr>
<td>(P) What happens when working with an engine combustion chamber?</td>
<td>--</td>
<td>82%</td>
<td>86%</td>
</tr>
<tr>
<td>(D) What does the compression ratio mean?</td>
<td>--</td>
<td>13%</td>
<td>71%</td>
</tr>
</tbody>
</table>
Access to the authentic learning environments, materials, resources, artifacts and expertise has increased minority students’ STEM knowledge acquisition, retention, application and valued output in challenging domains. They are American children who know they can compete.

References


That None Shall Perish

Panelist

Kelly Mack, Ph.D.
Vice President for Undergraduate STEM Education
Association of American Colleges and Universities Executive Director
Project Kaleidoscope

Abstract

Projected shifts in U.S. undergraduate student composition not only make it increasingly likely that all institutions of higher education will experience significant growth in their underrepresented minority (URM) student enrollments, but also emphasize the need and urgency for immediate implementation of better pedagogies in STEM disciplines that are equally evidence-based and culturally competent. Indeed, recent data has identified that the most advanced mechanism for improving the participation, retention and graduation of underrepresented groups in the STEM fields is pedagogical reform (Tsui, 2007). To that end, professional development interventions aimed at exposing STEM faculty to enhanced STEM teaching strategies fail to inextricably link cultural sensitivity with advanced STEM pedagogies, are devoid of the elements of self-efficacy needed to sustain long-term implementation, and are often derailed as a result of misinterpretation or misapplication (Froyd, et al., 2005). As a result, modern teaching strategies continue to be implemented at varying levels of precision and with only modest gains in STEM student success, particularly for URM students.

Background And Problem

Project Kaleidoscope (PKAL) is the center for STEM higher education reform within the Association of American Colleges and Universities (AAC&U). Since its founding in 1989, PKAL has been one of the leading advocates in the U.S. for transforming undergraduate STEM teaching and learning, and empowering STEM faculty to graduate more students in STEM fields who are competitively trained and liberally educated.

In its recent report, Engage to Excel, the President’s Council of Advisors on Science and Technology (PCAST) noted that the U.S. requires one million more STEM baccalaureates in the next decade (PCAST, 2012). Critically important to attaining the PCAST goal is the need to broaden the participation of underrepresented minorities who not only represent a rich source of talent, but are also the fastest growing populations in undergraduate higher education (Western Interstate Commission for Higher Education, 2008). In fact, Werf and Sabatier (2009) predict that by as soon as 2020, minority students will outnumber whites on U.S. college campuses.

These projected shifts in undergraduate student composition not only make it increasingly likely that all institutions of higher education will experience significant growth in their underrepresented student enrollments, but also emphasize the need and urgency for immediate pedagogical reform in STEM disciplines that is: 1) relevant to diverse student audiences; 2) readily transferable to all institution types; and 3) designed to cultivate, as opposed to weed out, academic talent.

While recent data have indicated that such pedagogical reform is the most advanced mechanism for improving the participation, retention and graduation of underrepresented groups in the STEM fields (Tsui, 2007), mastery of the pedagogy poses a substantial challenge for STEM faculty who oftentimes are not privy to the substantive knowledge of and proficiency in teaching strategies that would enable students to master STEM content while becoming skilled learners (Froyd, et al., 2005). Additionally, many professional development interventions aimed at exposing STEM faculty to enhanced STEM teaching strategies fail to inextricably link cultural sensitivity with advanced STEM pedagogies, are devoid of the elements of self-efficacy needed to sustain long-term implementation, and are often derailed as a result of misinterpretation or misapplication (Froyd, et al., 2005). As a result, modern teaching strategies continue to be implemented at varying levels of precision and with only modest gains in STEM student success, particularly for URM students.

Promising Practices and/or Solutions

Quality of teaching is one of the strongest and most consistent predictors of URM student interest and retention in science both as a major and as a career (Tsui, 2007). To that end, professional development of STEM faculty emerges as integral to increasing the number of URM STEM students who persist to degree; and is best facilitated by a dual-pronged approach that: 1) highlights those effective teaching practices that depart from traditional STEM teaching strategies and differentially impact URM STEM student success; and 2) incorporates the elements of STEM faculty self-efficacy needed to support sustained behavior change in modes of STEM content delivery.
High Impact Teaching Practices (HIPS) Differentially Improve Underrepresented Minority Student Success. Since 2005, AAC&U’s Liberal Education and America’s Promise (LEAP) initiative has sought to improve undergraduate teaching and educational outcomes by providing faculty with frameworks that address multiple dimensions of undergraduate learning and lead to essential learning outcomes, authentic assessment methods, and implementation of various high impact practices including, but not limited to inquiry-oriented first year seminars, collaborative problem-solving, undergraduate research, learning communities, and experiential learning.

While successful implementation of these pedagogies advantages all students, researchers suggest that utilizing these approaches creates the kind of supportive environments that are essential and differentially beneficial to URM student success (Kuh, 2008). Indeed, this AAC&U initiative has demonstrated that such educational practices not only enhance student gains in critical thinking and problem solving, but also disproportionately improve the graduation rates and educational gains for URM students (Finley and McNair, 2013).

STEM Faculty Regional Network Participation Leads to Higher Levels of Student Engagement. Many national reports and accompanying recommendations indicating the need for better STEM teaching methods rely upon the combined scientific acumen, cultural competence, pedagogical prowess, professional development and overall well-being of STEM faculty. However, few of these reports offer specific details on providing the kind of holistic approach to professional development that will fully support STEM faculty in implementing equally evidence-based and culturally relevant STEM teaching strategies.

PKAL has historically used its regional STEM faculty networks to promote modern changes to traditional modes of undergraduate STEM teaching for its community of 7,000+ STEM faculty from over 150 institutions of higher education. Each Network utilizes didactic presentations along with highly interactive sessions where faculty are presented with opportunities to demonstrate proficiency with new STEM pedagogical techniques, as well as reconsider and reflect upon past pedagogical performances. Recent preliminary data has revealed that, consequently, in institutions where STEM faculty have participated extensively in PKAL professional development activities, levels of student engagement among first-year STEM students—a common predictor of URM STEM student success—were significantly higher than those for the general student population.

Summary and Call To Action
For decades, national agencies have invested significant time and effort in delineating specific strategies for broadening the participation of URM students in the STEM disciplines. However, institutions of higher education have been severely challenged with implementation of these strategies primarily because of: 1) a lack of systemic organizational change efforts that take into account the limitations imposed by institutional barriers; 2) the exclusion of appropriate institutional stakeholders; and 3) the absence of the kind of effective faculty development that involves those self-efficacy enhancements most closely associated with sustained behavioral changes in STEM teaching and learning.

Project Kaleidoscope is committed to overcoming these challenges and empowering STEM faculty to produce more competitively trained and liberally educated STEM baccalaureates. As such, it is uniquely poised to collaboratively contribute to the efforts of national, regional and institutional policymakers in meeting the PCAST goal of ‘one million more.’ To that end, the following recommendations are suggested:

- **Organizational Change Effort.** Full consideration should be given to institutional transformation approaches to recruiting and retaining URM students in the STEM disciplines, which depart from the conventional “fix-the-student” model, and address infrastructural barriers to URM STEM student success;
- **Inclusion of Appropriate Institutional Stakeholders.** Opportunities that leverage the unique disposition of STEM professional societies are needed for structuring and expanding bi-directional communication between policymakers and STEM faculty in order to more fully inform policy decisions related to enhancing URM STEM student success; and
- **Effective STEM Faculty Professional Development.** Additional efforts and funding streams are needed for supporting meaningful professional development opportunities for STEM faculty to gain the levels of self-efficacy needed for sustained implementation of advanced STEM pedagogies that are relevant to diverse STEM student audiences.

In summary, the result of accurate and precise exposure of URM STEM students to better pedagogies that are equally evidence-based and culturally relevant is likely to result in both improved rates of retention and persistence to the STEM baccalaureate degree. Thus, efforts to empower STEM faculty to deliver such pedagogies, over time, not only contribute to U.S. preeminence in science and technology, but also yield a future generation of mentors and role models with the scientific expertise and cultural sensitivity needed for the robust same-gender and/or same-race mentoring relationships that are known to support both academic success in the STEM disciplines and better STEM career outcomes (Bettinger & Long, 2005; O’Neill, 2002).

References


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The world continues to change at an ever-increasing pace, which no longer is on a linear path. The rate of change has become exponential. As the world continues to change, how have our schools been asked to respond? By adding more tests, requirements, regulations, and rules to our existing 20th century school structure and continuing to prepare students for an outdated worldview of leaving K-12 education to enter college. As educators, we need to focus collectively on transforming school culture and systems. Added and environmental pressures—both internal and external—are reshaping education whether we choose to be active agents in the process or not. Our job as educators is to prepare students—ALL students—to enter this ever-changing world and become productive members of society, but how we do that has always been the challenge.

At the K-12 level, the No Child Left Behind Act of 2001 (NCLB) had substantial impact. With its mandates on state standards and increased emphasis on K-12 education’s accountability and results, NCLB was a well-intentioned bipartisan initiative. Although some of its requirements have proven to be very successful, it has also led to some unintended consequences: its narrower emphasis has focused mostly on who is not learning, not on why, what, and how students are (or are not) learning. What we have been measuring for the last decade is what is most easily measured, not what is most important to be learned in today’s rapidly changing world.

Changing the Status Quo
In our work at both the International Center for Leadership in Education and the Successful Practices Network, we have talked with schools, policy makers, educational institutions, and business and industry leaders to determine what skills and knowledge students need when they leave school to be prepared to be responsible citizens and contribute to the global and increasingly technology-enabled economy. We came to the conclusion that schools need to be on a path of prepar-
Preparing students for college and careers has long been a focus of education. However, the Common Core State Standards (CCSS) and Next Generation Assessments (NGA) were designed to raise the bar on what is being measured, and how learning is measured. Preparing students for college and careers has shifted the focus from merely knowledge acquisition and memorization to knowledge application and a deep level of problem solving. As states and local districts struggle with budgetary issues, the capacity of schools to implement, support, and sustain the new standards and assessments is even more challenging.

This shift is clearly illustrated and can be supported through the use of the Rigor/Relevance Framework® (Figure 10), a tool developed by the International Center to examine curriculum, instruction, and assessment. The Rigor/Relevance Framework is based on two dimensions: the Knowledge Taxonomy and the Application Model. As you see here, the vertical axis is the Knowledge Taxonomy, which is based on the six original levels of Bloom’s Taxonomy. Along the horizontal axis is the Application Model, which describes putting knowledge to use. Academic standards and state tests have historically been in the A quadrant; traditional career-technical education (CTE)—or ensuring that students are job-ready—falls into the B quadrant; college prep or “college ready” is found within the C quadrant; and “career ready” is found in the D quadrant. Many schools feel that they have been on a decade-long “forced march” to increase student performance as measured by our traditional tests. Those tests have typically measured the A quadrant of the Rigor/Relevance Framework. The call to make students “career ready” changes that focus from Quadrant A to Quadrant D.

That is a very substantial change in the 21st century school structure? The Common Core State Standards (CCSS) and Next Generation Assessments (NGA) were designed to raise the bar on what is being learned and how learning is measured. Preparing students for college and careers has shifted the focus from merely knowledge acquisition and memorization to knowledge application and a deep level of problem solving. As states and local districts struggle with budgetary issues, the capacity of schools to implement, support, and sustain the new standards and assessments is even more challenging.

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As some states and districts experience backlash to the implementation of the CCSS, we need to remember the issue is not the new standards or next generation assessments or new teacher evaluation requirements. The issue is simply, are students being adequately prepared for future success in their career experiences? New standards, assessments, and teacher evaluation are simply some of the strategies or tools designed to help students become college ready. They are a means to an end, not the end itself.

The job of educators should not focus on preparing students for the next grade or more school, but should ensure that—at whatever point students complete their formal education—they are ready to be productive members of society. Several emerging organizations and initiatives have the power to support the change in our schools’ focus using the new standards and assessments as a path and strategy to ensure our students are both college and career ready.

With these external and internal factors in play, K-12 education may look back on 2013 and 2014 as “the swing years” that provided a pivotal opportunity to shape its future direction. Education needs to change and adapt from where it has been to where it needs to go. In short, a reality check is needed, and the imperative to do so is now.

In a recent report, 64 percent of U.S. companies reported that they are struggling to hire candidates with experience or a background in management, science, computers, and engineering. Less than a third of all American students graduate with their first university degree in a field of science or engineering. The numbers are lower for minorities and females. In comparison, more than half of students in China who receive their first university degree do so in a science or engineering related field.


The world we live in continues to evolve and shows no signs of slowing down. What the future holds in terms of potential learning or jobs is uncertain and barely imaginable. As educators, we cannot assume that our past focus on college preparation or specific job training will be enough to prepare today’s students for what may lie ahead. The best option we have is to redefine and restructure teaching and learning in ways that equip more—ideally all—students to deal with the unexpected and adapt to changing circumstances. This will involve a level of retraining, not only in terms of professional development for teachers, but also in the
entire school community’s shift in culture—to become “learning organizations” rather than merely “schools.”

We live in an era of unprecedented access to information and core knowledge. Education must redefine itself: from learning what to learning how; from passive to active; and from acquiring and memorizing knowledge to using it. This learning environment or “learning organization” reflects NACME’s belief in “a community in which each member is encouraged and assisted to grow and develop.” The instructional role must evolve from knowledge-provider to learning-facilitator, using assessment as a learning tool, not just a checkpoint or gateway to the next level. Education leadership needs to modify its role as guard of “the system.” Leaders must challenge the rules, regulations, and practices that get in the way of adopting promising and proven next practices. By doing so, state, district, and school leaders can provide top-down support for bottom-up improvement that focuses on learning and achievement—not just for some, but for all students.

**Recommendations**

As the focus and goals of K-12 education undergo a dramatic shift, it will be crucial for educators—especially education leaders—to understand and embrace the following:

- **Culture trumps strategy.** First create and nurture a district and school vision and culture that “sees”, understands, and embraces the need for college AND career readiness for all students and recognizes that, of the two, “career-ready” is both a higher and a different skill-set. Without a shared, future-focused career-ready learning culture, other solutions and initiatives don’t make sense and will fail.

- **The Rigor/Relevance Framework®.** Organizational leaders, instructional leaders, and teachers need a common, aligned conceptual framework to inform and guide learning and instruction. The Rigor/Relevance Framework provides an accessible and practical conceptual model.

- **Focused and sustained professional development.** Teachers and teacher leaders need enhanced and different sets of instructional skills. Our world is becoming increasingly focused on application, problem solving and performance-based learning—Quadrants B and D.

- **Use data to drive continuous improvement.** Data must be used prudently, effectively, and unrelentingly to guide and measure learning. Instead of using tests to take snapshots of student achievement at a specific time, data must be collected regularly and consistently, and in multiple and varied ways including areas of focus, such as school culture. For example: have all students been encouraged to aspire to any and all professions or career pathways, especially including science, math, and engineering? The International Center’s **Learning Criteria** is a tool and process that addresses a wide array of ability and growth measures. See www.leadered.com/learningcriteria.html.
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Moderator
Raymond Dempsey
Vice President, External Affairs
BP America Inc.

Panelist
Marilyn Berry Thompson
Chair of Federal Practice
MWW Group
Comments made at the 2013 NACME National Symposium

Panelist
Irving Pressley McPhail, Ed.D.
President and Chief Executive Officer
National Action Council for Minorities in Engineering, Inc. (NACME)
Comments made at the 2013 NACME National Symposium

Panelist
Theodore M. Shaw, J.D.
Professor of Professional Practice in Law
Columbia Law School
Comments made at the 2013 NACME National Symposium
I’m not going to go back to filling you all in on the government shutdown, I have done that already and frankly it’s just too painful at this point. Minority Leader Nancy Pelosi (D-CA) is giving a press conference now and we’re going to have another series of votes today to try and divide people up. But there are enough votes now among moderate Republicans and the Democrats to pass a clean continuing resolution that will reopen the government. We just can’t figure out how to get it to the floor. That’s an in the weeds legislative process discussion, but later on if you want to ask questions about it, we’ll be glad to entertain them.

I’m going to start with a few executive branch policy issues and again I’m going to pose a lot of questions to you as I present these federal policy issues, because I certainly do not have the answers. That I know. But I do think that we all want to hear how you will feel about some of these issues that I outline for you.

First is what I’m going to call the focus, or the all too often lack of focus, at the federal level and a diverse STEM workforce. We hear a lot of talk about STEM, STEM, STEM, the Administration supporting STEM, but it has not always—there are some encouraging signs recently—but this has not always been the case. And every time an announcement would come out on STEM, my colleagues and I, Ellen Smith is here in the audience, and Alanna Suda, we would tear through the smallest line, the smallest footnote for any mention or reference of a diverse workforce, under-represented minorities in STEM. And all too often for a long, long period of time, there was silence on that part. Now, encouraging signs for those of you who were able to see Secretary Moniz’s video that he sent to us. He had pledged to come, wanted to come, one of our painful outcomes from the shutdown. He was not allowed to speak, but he did send us a video and he made it clear how important NACME was, which is always good to hear to be reinforced. But more importantly, how critical important this issue is of having a diverse workforce and one of the encouraging signs if you’ve not heard this before and one of the first things Secretary Moniz did when he took office was he went up to Capitol Hill in front of the chairman and the ranking Democrat Rep. Eddie Bernice Johnson of the Science and Technology Committee, and made a very special point of how important this issue was. That was unprecedented. We were jubilant. Then when he officially took over as Secretary, one of the first things he did was to announce that he was going to start a special initiative focusing on the Department of Energy and minorities, from science to the STEM workforce issue and beyond. We are so proud that two of the individuals that he tapped first, to work with him, were our own Dr. McPhail and our own Ray Dempsey, Jr. Those are promising things, followed quickly by a memorandum that went out from the White House from both OMB and OSTP and all the agency heads and some of you, forgive me if you’ve heard this before in some of the other panels, but it made a point of giving them some guidance that when they were shaping their 2015 budgets. Mind you we still, we still don’t have a 2014 budget, but when shaping the 2015 budgets they need to make certain that they are addressing STEM and within STEM the issue of underrepresented minorities, so progress. But the point is and as some of you again may have heard my story about Dr. McPhail and I having breakfast with the Honorable John Lewis of Atlanta, and Dr. McPhail was querying John Lewis about how do you get this message through, how do we really make a difference, and the wonderful John Lewis said to us, “Make noise; lots of noise and persist. Do not give up.” So, again, that is our message to you. And anytime you see the federal policy come out on STEM or a program come out on STEM and it doesn’t include this as a focus, call them out on it. If they don’t hear from you, they will think its ok to not focus on that.

That’s policy one. Then comes the Administration’s FY2014 budget plan for STEM. Some pros and some cons. The Administration did make STEM one of
their top interagency initiatives in the 2014 budget that they released in February. And, there was no significant increase for STEM funding. What it was, was moving the pieces on the chess board, right? So, they took STEM functions away from every other science and mission agency from NASA to NOAA to Defense to Energy and they gave all that money to Secretary Duncan at the Department of Education and they kept the National Science Foundation STEM programs, which are primarily human resource support, fellowships, scholarships, some research and evaluation work, but they kept them just about steady. No major increase. And they told us that the Department of Education, that they were going to use the bulk of that money on K-12. Ok, we can have that debate here, they were leaving NSF to be in charge at the undergraduate, graduate, post-doctorate level, but otherwise the whole focus was going to be at the Department of Education. Now, I don’t know how some of you feel about that, but we have had some terrific commitments on STEM and minority and diversity in the STEM workforce with NASA, with NOAA, with the Department of Energy as I’ve alluded and the Department of Defense, and to see them lose their ability to make that kind of commitment and regular investment and interaction with us, that was disappointing to some of us. So, my question to you, and I will tell you that Congress is not accepting it; the House and the Senate, Democrats and Republicans have not approved this reorganization. The Administration is still trying to find a way to implement it and go forward with it in any case. But one of the questions that I would put to you all is, what’s your reaction to that? What do you think? Is that a good thing or a bad thing? And they are going to channel most of it through “Race to the Top.”

For a pro: Incorporated within the Department of Education spending plan was a plan to focus some new resources on regional based initiatives. Well, that’s exactly one of the highest priorities of NACME, is the regional implementation strategy, and that was exciting to us. So, I want to make sure I do the pro and the con. This was very definitely a pro. But, in the meantime, if you take the Department of Defense, the Department of Defense has tripled the amount of money that it is spending on minority STEM initiatives, primarily going directly to institutions and primarily to HBCUs, minority serving institutions and Hispanic serving institutions. But they have also sent directives across all the different services: Air Force; Navy; DARPA, etc. saying that the secretary is directing them to make certain that they are focused on STEM and minority STEM needs in a pervasive way across all the services and through all their programs. That’s really important. And we’ve got language in the House and Senate bills this year for defense authorization and appropriations to reinforce that. Now you have a policy that is to take that money and those precious resources away from the Department of Defense and certainly that’s happening with Energy too. The Moniz initiative is critical, but you have tremendous opportunities developing at Energy.

Ellen Smith and I, we help universities find money. How many of you out there are from a university? Grand announcements: In the Senate bill on clean energy, which is a bipartisan bill, which right now is being killed because of this feud that’s going on, they have tucked into the energy efficiency bill provisions that would establish training and assessments centers at institutions of higher learning to identify and promote opportunities, concepts and technologies to expand building energy and environmental performance. Great role for engineering schools across the board; I point that out to you, the bill is called Shaheen-Portman, say a little prayer that it survives. The same week that that was occurring, the Department of Energy announced that it was going to establish a hundred million dollars worth of new energy frontier research centers. This announcement did not highlight minority STEM, or underrepresented minorities, but it is a marvelous opportunity. They are going forward with this, centers are going to be funded at roughly two to four million dollars. I urge you that when you go back to your universities to start tracking that down and put together a consortium even if your institution is not prepared to be the primary contractor, the PI for a consortium, make sure that minority STEM workforce is included in your plans.

I’m going to come very quickly to a sensitive issue. Federal agencies tend to address the diversity in STEM workforce issue primarily through offering RFP competitions to individual institutions. A consortium of institutions and as Dr. McPhail mentioned in one panel and our wonderful NACME Board member Eileen Campbell from Marathon Oil highlighted in her presentation yesterday, we need to make certain that the federal agencies recognize the role of non-profits like NACME, because we bring so much to the table and it can’t all happen through individual institutions as I’m sure you recognize. Here’s the sensitive part, on top of that they are primarily putting out RFP’s and funding opportunities through individual HBCU’s, MSI’s, and HSI’s. I represent HBCU’s, places like Morehouse and so I’m a strong HBCU supporter. My question to you, is that the right way to do that? Is that the right policy? I think the answer is to do both, to do it all. But right now that is primarily the main root that the agencies choose. NACME has certain federal policy recommendations for the agencies that I will just quickly elaborate on. One is to make certain that the role of non-profit entities like NACME are recognized in federal legislation, in federal programs and by federal agencies and are allowed and made eligible to participate. Second, what NACME does and all of its wonderful corporate supporters in raising so much scholarship money. What NACME raises in scholarships and what another group like Thurgood Marshall College Fund raises, if you put the two of them together you exceed the total that the federal government is putting in across the board for minority scholars in STEM. What if we were to find the right way to join those funds, use those funds to leverage funds from them and vice versa. So, we’re trying to endorse and support that as a concept. And thirdly, I think what we heard from everybody and from many, many panelists yesterday across the board was how important it was to make certain that minority scholars are having opportunities to train and to learn to do research in not just corporations, but absolutely corporations, but also within the federal labs and the federally designated centers of excellence. We’ve got a number of opportunities available to us over the next few months to year, to make sure that these kinds of policies are rightly highlighted, emphasized, funded. Not the least
of which is the whole reauthorization of the Higher Education Act, the reauthorization of America COMPETES Act, the finalization of the 2014 budget, which they will still have to do; and the finalization and shaping of the 2015 budget. Active participation it’s not just talk, it really makes a difference. Now there’s one last federal policy. I don’t think we’ll have time to get into immigration, but I’m just going to mention immigration, Dr. McPhail, in case you want to touch on it.

What’s going on in the world of college affordability and student aid support? I think you all have heard the speeches by President Obama in August and Secretary Duncan; they have launched at the Administration level, the College Affordability and Values Outreach initiative, an agenda intended to, “slow rising tuition costs and provide students with information to make informed decisions.” Now we call this the college scorecard. One of our concerns is, while this may be an unavoidable policy, how is it going to affect struggling institutions and institutions that primarily provide access and a home and an opportunity for low income and minority students including HBCU’s, MSI’s and HSI’s? Keep an eye on that because that is a very, very big issue here in Washington. The second thing is you’ve all seen, I think, the rising default rate for student loans. The two-year cohort default rate has gone from 9.1 percent to 10 percent on average and the three year cohort rate, which is mandated now in the Higher Education Act, has gone from 13.4 percent to 14.7 percent. Our scholars are suffering. They are being crunched. And then the Administration threw something at us that we just couldn’t believe. I don’t know how many of you are familiar with the Student Plus loan crisis, but they retroactively changed how your credit ratings would be assessed. Families who had made a decision to send their kid to college, and maybe put off their mortgage payment got really nailed. So, 400,000 kids were thrown out of school, were denied credit. A large, large percentage of those were minority students and were at minority serving institutions and HBCUs. It took a year’s battle, but two weeks ago the secretary finally issued abject public policy about how this had been handled by the Department of Education and has sworn that if people appeal their decisions, they will be addressed. But, I think as you know, if your pathway is seriously interrupted, you may never go back. If you’ve lost your opportunity to stay, and this happened to kids already in school, not just new enrollees. If you were planning to go and then all of a sudden there are no resources to go, or if you were already there and got kicked out, you may totally change your pathway. These student aid policies and this college rating system, college scorecards, collectively put real pressure and undermine the progress we’re trying to make of having more minority scholars in the STEM arena. With that, I’m going to turn this back to Ray Dempsey, Jr. and to Ted Shaw, who will give you really serious guidance, and to Dr. McPhail.

Thank you very much and please, when we get to the Q&A section, I urge you to ask lots of questions, we need your interaction and help. Thank you all.
Panelist
Irving Pressley McPhail, Ed.D.
President and Chief Executive Officer
National Action Council for Minorities in Engineering, Inc. (NACME)

Comments made at the 2013 NACME National Symposium

I intend to be brief and to make one major point. I’d like to reflect on the session right before lunch where we focused on reform in pedagogy, K-12 and beyond. Each of our distinguished panelists cited the intersection of culture, cognition, and STEM learning. Etta Hollins’ work in culturally-mediated instruction, Robert Moses’ Algebra Project, and Jamie Bracey’s use of high verve communal learning, expert mentoring, and cognitive apprenticeship instructional strategies in learning robotics are examples. These new directions emphasize a paradigm shift in the way we look at science, technology, engineering, and mathematics teaching and learning with learners of color. This is precisely the paradigm shift that should influence federal funding and STEM policy.
Good afternoon. I’m honored to be here. I’ve been with NACME now several times over the NACME office. I say I came over because I live in New Rochelle, N.Y. and NACME is in White Plains, N.Y. So, it’s a hop, skip and a jump. I came over to talk about what was expected. It was early in June, no later, and on the docket at the Supreme Court as many of you may know was a case called Fisher vs. University of Texas, Austin and this was a very busy Supreme Court term for civil rights cases. There were same sex marriage cases. There were several unemployment discrimination cases. The courts also had the constitutionality of the voting rights act and you know what happened there. And there was Fisher. That was a busy term and they all came down in the last week. Well, we met in anticipation of Fisher, because I had been involved, as many of us have been in one way or another, with these battles for many, many years now and the anticipation was that this might be the occasion in which the Supreme Court finally struck a blow against diversity efforts, which are of course very important to the work that NACME and others are doing with respect to diversity in STEM fields and there was a deep concern about whether or not NACME and other programs should change their goals, maybe not their goals, but how they articulate their goals, how they define their mission, how they identify who they’re trying to reach, etc. So, I want to talk about that a little, but, as it turned out Fisher was a bit of a fizzle. I’m glad about that. I’ll say a little bit more. But it doesn’t mean that these struggles are over, let me give some context.

I was sitting in the other session at lunch time and I was thinking about the 21st century technological issues that were before us and for a moment—like the dinosaur I’m increasingly becoming—because these battles about race, diversity, affirmative action we could talk about terminology, but these battles feel so 20th century, like we ought to be beyond them, particularly in the age of Obama and the 21st century in which we’re told that we’re living in post-racial America. And I was reflecting on the age of Obama and “post-racialism” in quotes because I think there’s a lot that pushes our discourses, in plural, because there’s a social discourse, a political discourse, and legal. And more and more I think these discourses are separating and going in different directions. I’ll explain what I mean about that. Of course, the background to all of these issues is our nation’s long history of struggles with race. If any of you had heard me talk about these issues before, I have a standard part of my talk in which I cause people’s eyes or many people’s eyes to roll up in their heads because they don’t want to hear this piece. And it has to do with perspective, temporal perspective and race. The short version of that is to say that we like to antique slavery and Jim Crow, and first of all, separate slavery and Jim Crow as if they’re not part of the same continuum, which spans from 1619 until about 1969 or ‘68. Really, after the assignation of Dr. Martin Luther King, Jr. because it was only after that happened that a lot of universities began to consciously really go to work to admit students of color and most of that discourse up until that time was a black-white discourse for reasons that we understand. Slavery dilemma was part of our original constitution although we have never been a binary society, but we certainly aren’t now. But the reason that we usually go through that is, because if think about where we are on these issues. You’ve got to start with respect to diversity with the Bakke case in 1978, because that was the first time that the Supreme Court finally ruled it had been presented with a case that was up in the court four years. Before that in 1974 involving the University of Washington Law School, but they were able to duck the issue because he was about to graduate and he had been provisionally admitted pending the outcome of the litigation.

The point is this, the attack on what came to be known as affirmative action and it’s important to underscore that efforts to open up opportunities to people of color, first African Americans, Latinos, Native Americans. It didn’t begin as a diversity initiative. It began as a remedial initiative rooted in that long history and so there was 350 years of governmental subordination. In the colonial era and after the United States came into being and right on up through the end of that 350 years of governmental subordination, that is by law. Then about four years after affirmative action and higher education really picked up steam, the Supreme Court considered these reverse discrimination cases. So, it was an immediate attack. And it culminated in Bakke v. the Board of Education. It’s in Bakke that you get the diversity rationale and effectively you get the remedial rationale thrown under the bus, and then the assault on diversity begins and that battle continues for 25 years. I can fill in those descriptions with a great deal more detail, but time doesn’t permit. You get a 20 year battle; the Michigan cases in 2003 and 2004, the change in the Supreme Court. It’s because of that change in the Supreme Court that
The Supreme Court basically didn’t deliver the death blow that people anticipated that we feared might happen, but what it did was choke or strangle diversity efforts a little bit. They squeezed a little bit or that’s what they’re appearing to do. We’ve long said that strict scrutiny, which is the standard that applies to race conscious measures, shouldn’t be strict in theory and fatal. In fact, what the court is saying now is it shouldn’t be strict in theory, but in fact be a weak review. It has to be a stronger review. We don’t know what that means yet. We don’t know where that’s going to lead us. University general counsels are risk adverse. So, the concern is that folks don’t stampede because it’s so important to continue these efforts.

The battle over diversity in STEM fields takes on a couple of different elements or nuances that I want to share, so when many of us who are involved in the Michigan cases, and in other battles concerning these issues, would talk about diversity and how it worked and what it brought to the classrooms. People were quick to say what about science and math, we understand what diversity means in the context of and what it can bring in the context of social science or even law, where I teach. Can I share a quick example of that? When I was in law school I took a class in evidence. The professor was a federal court Judge by the name of Jack Weinstein who sits in the eastern district of New York, and still sits in senior status. We were looking at a case very quick, where it was a homicide, the suspect was I think both black, and Latino, lived in New York City, and it was in the 1960’s. The woman killed was white; there was no eye witness or anything, just circumstantial evidence. Under the body they found sheared off stocking caps and the people who sat in front of the class, usually they were not people of color, they raised their hands when Judge Weinstein asked about the strength of the conviction, if that was the only evidence that was submitted and thought the evidence was strong, that “it must have been some kind of sexual pervert, why would he have stocking caps?” And by the way, they were different colors than the stocking caps that were found at home in his drawer, which they used to link him to the crime. You know where I’m going. And when the judge finally said, anybody thinks that this is a weak conviction, all of the people of color raised their hands and I happened to be the one to explain, that at that time almost every Black man would have in his drawer stocking caps, a lot of folks still didn’t get it. So, we explained. But that was a story about diversity; the importance in the classroom, but also the lack of diversity in the DA’s office, because the case never should have been prosecuted, if it was on that theory. So, you see that connection.

So, what people would say, to jump back into STEM, is that’s one thing in social sciences or in law school, but in STEM fields, biology, physics, whatever, science is science. You have to have another analysis, what does it matter. It doesn’t matter what color you are in the classroom when you’re talking about biology or when you’re doing mathematics or quantum physics. It is, what it is. Well, in fact there have been studies that show even if we’re not talking about the substance of STEM fields, that the dynamics with respect to the collaboration that goes across different groups is a dynamic that can add to the educational process, but there’s also substantive importance when we talk about medicine for example that can be affected by diversity in the classroom. But these were the discussions that lawyers were having when we tried to fill in the blanks about what diversity meant, so we could tell the court why it was important and what was the compelling interest that supported diversity. And, in another sense STEM fields or the concern about America’s place with respect to being able to produce folks who work in STEM fields in a competitive, international marketplace, goes to another part of the analysis that the courts have brought. You have to have a compelling interest, compelling state interest to justify consideration of race.

And so what folks at NACME and in other universities and institutions, associations of higher education tell us is that this country is in trouble. We’re in trouble in part because the demographics of the country [are] changing and if we don’t increase the pool of people who are going to be working in STEM fields we have not only a competitiveness problem, we have national security problems. So, there is a compelling interest and that’s clear. So, we have 21st century problems and this 20th century battle over race that is still continuing, with a Supreme Court now that is dominated, albeit very narrowly by one vote, by a conservative block led by aChief Justice who comes right out of those 20th century battles. He is my age, he’s part of that struggle and was in the Reagan Administration and has demonstrated all his life on a straight line that he is the intellectual heir of his mentor former Chief Justice Bill Rehnquist, who himself was on a straight line all his life and it was a line that was walking against the interest, the interest of people of color, particularly African Americans. So, that battle is still going on, but their ability to win that battle is slipping away because the demographics of the country, as we have talked about, are changing. It is a challenge, all the material we saw about age and everything else. I get that. At the same time the racial demographics of the country are changing so that the bottom line is that they’re trying to strike this blow, Fisher was an opportunity. Before the demographics go where we know they’re going and also before political control of the mechanisms of government, which of course determine who sits on the Court and how likely they are to be able to continue to dominate with respect to the jurisprudence, which then sets the stage for whether or not we are legally able to do what we’re trying to do with respect to diversity efforts in STEM fields. Do you get the picture? In the interest of time, I’ll leave it there. But the country is not only in this place where we’re supposed to be post-racial, but we have a president who himself is bi-racial and also is unable to talk about race openly or limited and constrained. So, it’s a difficult time. We dodged a bullet. The bottom line is that institutions for the time being, still can continue to pursue these efforts in STEM fields and we’re compelled to do it for all the reasons that we know. So, we live to fight another day, but this fight isn’t over. And NACME has played an important role and needs to continue to play an important role in trying to open doors of opportunity to people of color in STEM fields. Because it’s not only in their interest, that is people of colors’ interest, it’s in the country’s interest.
Ensuring a Diverse Engineering Workforce

Moderator

Susan M. Lewis
Vice President for Environment, Health & Safety
The Dow Chemical Company

Plenary Speaker

Anthony Carnevale, Ph.D.
Professor and Director, Center on Education and the Workforce
Georgetown University
Comments made at the 2013 NACME National Symposium

Panelist

Stephen Barkanic
Senior Vice President and Chief Program Officer
Business-Higher Education Forum
BHEF’s STEM Higher Education and Workforce Project:
Forging New, Deeper Collaborations between Business
& Higher Education to Address STEM Workforce Needs

Panelist

Sue Barsamian
Vice President of Global Operations, Software
Hewlett-Packard Company
Comments made at the 2013 NACME National Symposium

Panelist

Mary Wright
Program Director
Building Economic Opportunity
Jobs for the Future
Building STEM Education Pathways for Underrepresented Minorities
What I want to begin with is to say a couple of things that generally come up with higher education audiences, not here so much. But there is a tension nowadays between higher education, American industry, American students, and their parents, I think, and certainly with the government and that is, that we’ve come to a point in our history where while higher education still serves a very important function as an institution that tries to empower individuals to live fully in their time, free from economic or public dependency, it has a much stronger economic function than it did long ago. An economic function that most economists would argue began to increase in power in the early 1980’s when the economy began to reorganize itself and as a result of that restructuring of the economy it is now the case that higher education is really the arbiter of middle class status. That is, it’s not just the preferred pathway to the American middle class, the American dream or good wages, however you want to say it. It is the most well-travelled pathway now and people who don’t get higher education have a very difficult time moving into or staying in the American middle class. In the 1970’s by ways of comparison about 7 percent of American workers had a high school degree or less and most of them were in the middle class, if you mean middle class for family income in the United States. We’ve shifted considerably, now only about 15 percent of people with a high school degree or less who are new entrants to the labor market manage to get entry to the middle class and a smaller share than that, mostly males, manage with high school only or even in some cases, very rare, less than high school to enter the middle class.

For females, middle class really begins at about the AA (Associate of Arts) level, not with the certificates, which were less than an AA degree, that is [they] require less time and are not degrees. They work for a lot of men, but they don’t work very well for women, so that the AA tends to be the point at which females get traction and in the final analysis, one of the things that has happened as a result of this shift, is that there is essentially a new phase in the life cycle for American youth, which is this post-secondary phase; the phase that occurs after high school and before family formation where people get traction in the labor market. Whereas in the 1980’s, at about age 26, most young Americans began to get traction that led to sustained career pathways and family formation. For all Americans that shifted to a little over age 30, for African Americans it’s almost at age 34 and it looks as if over time, we’re not sure over this recession, somewhere between ages 30 and 33 are really the point at which the on-ramp begins to work for American youth. And the essential difference between the old days and now is the need for human capital development after high school, because that human capital development is now more and more necessary for entry into a sustained career in middle class earnings and those are both necessary for family formation.

We’ve entered into a new era here and we don’t really have the tools to cope with it. We’ve never figured out how to pay for a new phase in a life cycle with public money. That is, higher education while it is substantially public and falls far short in terms of public funding of what’s necessary if we were to successfully educate 60-65 percent of our young people for middle class pathways. We’re a good $200 billion short of that goal at the moment. If that goal and a similar number for the President’s goal or the Lumina Foundation goal or the Gates Foundation goal, which are all essentially similar, and is to say roughly speaking that we’d become number one again in higher production, which we were until 1992. But we’re not anymore. So, there is a context in which this issue of STEM education occurs that in a sense is a subset of that context.

We know that since 1980-81 when technology intervened and began to restructure American jobs such that we began to automate very aggressively any function, activity or job task that was repetitive and left the non-repetitive to workers more and more, empowered with more and more flexible technology. In an era when the economy shifted from industry to services, and services inherently require more skill than a manufacturing economy does, and a broader set of skills, and at the same time when that skill set shifted beyond knowledge that can be acquired at an entry level job, more and more shifted back toward educational preparation, not because employers weren’t training, but because they were and they are doing so much more now. It’s just that the entry level to jobs that teach you things at which you can continue to learn, jobs in which you use flexible and powerful technology require a whole new set of skills. In the old days the competitive requirement in the industry was high volume production of standardized goods at least costs. That’s not the case anymore, especially in a service economy. You’ve got to deliver quality, variety, customization...
and convenience, speed of operations, innovation, and you have to do that on a global scale, which requires institutions that are complex networks, which in and of themselves require workers who can work with other people successfully and workers who can work in complex institutional environments, which require whole new sets of skills, not just cognitive skills like problems solving, but soft skills like interpersonal skills, conscientiousness, and a whole series of things which we only used to require from the bosses, but we now require for more and more of the workers.

So, STEM is a special case of that story. STEM became more and more important after 1981 when the economy began to restructure itself very rapidly. A lot of the work, a lot of the restructuring that occurred came from STEM, especially the computer dimension to STEM, which is the largest piece of STEM work. Although STEM grows, it still makes up only about 7 percent of American workers, but it contributes almost twice that in value added so far as we can measure by earnings and some other metrics. So, it is a very important sector. It has become increasingly difficult to move minorities into STEM positions I think, based on our own work and others for a variety of reasons. One is a general problem and the general problem is that a very large share of African Americans, Latinos and lower income students are not prepared to do college work let alone STEM, which tends to require higher math skills and other skills at college entry, as well. And one of the striking things about that problem, I think, is that more and more it is not about race-conscious discrimination, although that still exists. White people don’t think black [people] are inferior, but white people, we know from opinion polls, hold black people in low opinion; which in fact has many of the same effects as old fashioned racism in the final analysis. But there is a shift in the sense that the institutions that now produce barriers to opportunity for minorities and low income kids are not necessarily race or color or class conscious, they’re effectively race-blind and color-blind, but we know increasingly in the data, the most striking thing is that these race-neutral intuitions, economic institutions, educational institutions, housing, the distribution of residential markets, neighborhoods, quality of schools, all the rest of it, while they’re not color-blind they systematically produce lower levels of opportunity for minorities, that is African Americans, Latinos, and lower income students. And we know that it isn’t because these students don’t have the capability to do the work. That’s not the problem. When we measure these students when they’re five or six years old or, second or third grade, which we used to do at Educational Testing Services where I used to work. When we measured them in the early grades and then measure them again at age 18, which we did with the ACT and the SAT and a variety of other instruments, one of the striking findings that is consistent throughout the history of measurement in this area is that if you take a low income kid, especially a low income minority kid, and you measure them at age seven or eight and you look at them, at their scores, at age 17 or 18, what you discover is there is no relationship between their measured ability when they’re kids and their measured ability when they’re about ready to go to college. If you look at a kid who comes from a family with above average family income and especially if they’re White, what you find is that the measure of ability, it’s not IQ, because we don’t say that anymore, but when we measure ability at age two, three, or four or measure in the 3rd, 4th or 5th grade and measure it again when they’re 18, the score they get when they’re kids, predicts the score they get when they’re 18. In other words, they became all they could be in general. Whereas the majority of low income kids don’t, so something happens. Now the big issue in the United States and in social policy always is, what happens? And whose fault is it? Nonetheless, it is very clear that something happens, or something doesn’t happen for a lot of these kids. And that is the more modern version of the problem with our race and with class in the United States. It is not so in other parts of the world. This is a phenomenon we’ve known in Europe and in South America, oddly enough in the last 50 or 60 years. It is what disadvantage turns into over time; once civil rights are secured, it’s never quite enough. Because what we know is that advantage, as well as disadvantage is the creature of many, many causes. It’s very complicated. And that unless and until you can handle all of those causes, which is a herculean task without disrupting the basic structure of the economy and the education system, you’ve got trouble.

So, in the end, the other final comment about this as it relates to STEM is, if you are a young, low income working class or minority student, and you’ve got good math scores, the truth is from an economic point of view, STEM is not your best bet. We know that STEM wages are high, they are among the top three; petroleum engineer is number one for a college graduate at about $120,000 per year. But, when you look on average to the Bachelor of Arts, and Bachelor of Arts plus jobs, graduate schools, across health care, business, information and more traditional STEM, all three: health care, business and information, beat STEM. So, if you’re good at math, you can make a lot more money doing something other than STEM. [That’s] the plain truth in the United States, plus you don’t have to go to lab on Saturday.

The other point here and the last point I’ll make is [from] our own research and we find over and over again is that values and interest intervene here. One of the reasons a lot of kids don’t pursue STEM even though they have high math scores is that they’re not interested, and they don’t carry the particular interests and values that are associated with STEM, and there are particular values and interests associated with STEM and they are different for other kinds of majors and other kinds of occupations. So, there is a barrier here that has to do with social structure, one that has to do, as well, with the structure of our labor market, and a third one that has to do with the values and interest among young people with opportunity.

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National Action Council for Minorities in Engineering, Inc. (NACME)
Panelist
Stephen Barkanic
Senior Vice President and Chief Program Officer
Business-Higher Education Forum (BHEF)

Challenge
Innovations in science and engineering have driven economic growth in the United States over the last five decades and, during this period, the U.S. enjoyed world leadership in science, technology, engineering, and mathematics (STEM) workforce development. According to the President’s Council of Advisors on Science & Technology (PCAST) in its February 2012 report to the President, if the United States wants to remain the competitive frontrunner in these fields, the nation will require approximately 1 million more science, technology, engineering, and mathematics (STEM) professionals than what will be produced at current rates over the next decade. Further projections suggest that STEM-related employment opportunities will grow nearly 17 percent over the next decade, and that more than 60 percent of those jobs will require a college degree or higher. As a paradox, fewer than 50 percent of students who enter college intending to major in a STEM field complete a STEM degree; the majority switches to non-STEM majors during their first two years of study. In order to increase this retention percentage, PCAST recommends focusing on these critical first two years of undergraduate education.

Solution
In spring 2011, the Business-Higher Education Forum (BHEF) introduced the BHEF STEM Higher Education and Workforce Project to address the STEM retention challenge and align higher education with national and regional STEM workforce needs. Comprised of Fortune 500 CEOs and presidents of respected research colleges and universities, BHEF is the nation’s oldest and only organization dedicated to creating innovative solutions to address the gaps between higher education and the professional workforce. The BHEF STEM Higher Education and Workforce Project connects the deployment of regional projects; research and systems dynamics modeling; and a national STEM partnership strategy through organic partnerships between BHEF member corporations and higher learning institutions, the Project’s goals include:

• Increasing undergraduate student retention (particularly women and underrepresented minorities) beyond the first two years in a STEM major and producing graduates in high-need STEM disciplines;
• Deepening STEM learning and increasing the relevance of studies to skills and careers, with a focus on the first two years of college;
• Strengthening the alignment of undergraduate STEM education and degree production with government and industry regional workforce needs, with a focus on high-demand STEM fields;
• Demonstrating the efficacy of different intervention strategies, proven highly-effective in retaining STEM undergraduate students and modeling such interventions to simulate their impact at scale; and
• Developing a national network to scale evidence-based practices and influence broader policy through collaborations among government, business, and higher education association members.

Regional Project Strategy
BHEF Chair William (“Brit”) Kirwan, Chancellor of the University System of Maryland, in partnership with Vice Chair Wes Bush, CEO of Northrop Grumman Corporation, officially launched the first BHEF regional project, addressing Maryland’s critical technology workforce shortages via the nation’s first undergraduate cybersecurity honors program. Other emerging projects in California, Florida, Maryland, Massachusetts, Missouri, New York, Ohio, Texas, and Wisconsin focus on their region’s unique workforce gaps.

The BHEF STEM Higher Education and Workforce Projects are locally-developed in response to each region’s STEM resources available and workforce needs. BHEF business, higher education, and government members are matched and guided by BHEF as they collaborate to define the highest impact intervention strategies, meaning, ‘how do we engage these students in STEM?’, then create new education models and curriculum, asking, ‘what do they need to be taught to be relevant in their region’s economic workforce?’

BHEF regional projects will utilize innovative education models to tackle our nation’s grand economic and national security challenges in cybersecurity; clean...
water; sustainable energy; entrepreneurship and innovation around chemistry and materials science; and agriculture and food sciences. Once developed, similarly themed projects will be networked to collaborate and share expertise and learning outcomes with the nation. Additionally, they represent hubs for testing, linking, and leveraging different strategies that are founded on an evidence base of effective practice. In effect, each regional model will become a national proof point for innovative education practice through deeper engagement between business and higher education.

**BHEF Creates First Systems Dynamic Model to Prove Strategic Efficacy**

In 2006, Raytheon Chairman and CEO William (“Bill”) Swanson commissioned a team of Raytheon engineers to work with BHEF staff to create the first of its kind, a system dynamics model to help policymakers, educators, and researchers: (1) map the complex structure of the U.S. STEM education system and; (2) identify potential solutions that could help strengthen student outcomes in STEM. This effort produced the *BHEF U.S. STEM Education Model®* which is owned and managed by BHEF. In October 2011, BHEF received a multi-year grant from the Office of Naval Research to develop an expanded version of the Model, retooled to target high-leverage interventions directly related to the Navy’s workforce. The resulting hybrid BHEF U.S. STEM Education Model will allow the Navy to view outcomes associated with its current higher education investment portfolio, and provide a tool to better understand high-impact interventions and Navy-specific leverage points.

**National STEM Partnership Strategy**

BHEF leverages key alliances, builds a robust advocacy voice, and bridges the information gap with timely, evidence-based policy and research briefs. Tactics are strategically implemented to:

- Increase STEM student retention, particularly among women and under-represented minorities;
- Deepen STEM learning; and
- Align undergraduate STEM education to regional workforce requirements

BHEF has initiated discussions with prominent higher education and industry associations to develop a national approach to align research, advocacy, and scale best practices in undergraduate STEM education. The agenda will focus on the first two years of post-secondary and the alignment of higher education to workforce. Led by BHEF, this network will create and advance a national STEM higher education strategy and influence domestic policy. It will also serve to disseminate and scale effective intervention strategies developed through BHEF regional pilots. Lastly, it will also serve as a highly-visible communication and advocacy vehicle to fill the policy gap in the STEM pipeline between Pre-K through 12 and the workforce.

Participating university and industry associations include: the American Society for Engineering Education; Association of American Universities; American Council on Education; Association of Public and Land-Grant Universities; Aerospace Industry of America; Business and Industry STEM Education Coalition; National Defense Industry Association; and TechNet.

BHEF has launched a new series of policy and research briefs using unique longitudinal data sets that capture student career interest and student proficiency in four core areas. These briefs are designed to deepen thought leaders’ understanding of the STEM challenges and provide new insights for fashioning solutions. These solutions will be shaped using the BHEF U.S. STEM Education Model and the results of the modeling, as well as regional pilots, will be disseminated through BHEF’s evidence-based resource center, StrategicEdSolutions.org®.

**About the Business-Higher Education Forum**

BHEF is the nation’s oldest organization of senior business and higher education executives dedicated to advancing innovative solutions to U.S. education and workforce challenges. Composed of Fortune 500 CEOs, prominent college and university presidents, and other leaders, BHEF addresses issues fundamental to our global competitiveness. It does so through two initiatives: the College Readiness, Access, and Success Initiative (CRI), addressing college- and work-readiness, access, and success; and the Securing America’s Leadership in Science, Technology, Engineering, and Mathematics (STEM) Initiative, promoting America’s leadership in STEM. BHEF and its members drive change locally, work to influence public policy at the national and state levels, and inspire other leaders to act. Learn more at www.bhef.com.
But, in order to do that you’ve got to make sure that the companies are engaging with you at the right level. And that’s usually, in large companies, a pretty multifaceted equation. So, I’m going to give you a little bit of insight into how we tackle that at HP and what’s really starting to work for us.

We originally came to this as many companies come to this topic from more of a philanthropic and social innovation perspective. It’s good for the world; it’s good for the United States to have a STEM workforce and to have underrepresented minorities in that workforce. That’s a great goal. HP is 75 years old, many think of HP as the founding company or one of the founding companies in Silicon Valley. It’s incredibly important to us [that] the U.S. has a vibrant, growing and viable STEM workforce and we completely buy into NACME’s vision and charter that the workforce looks like the rest of America. So, being in this for social innovation reasons for a company like HP is very valid, but often not enough. When times get tough in a company and things are cut, what you really find is that you’ve got to also have that link to business imperative. What we’ve tried to ramp up at HP to make sure that we’re balancing [a] two-pronged approach to this topic. What is HP’s role in making sure that the STEM workforce in the U.S. is alive and thriving? And how is HP going to use that to further HP’s corporate objectives and missions and where does this goal fit into that?

So, what we did about 18 months ago is we invited Dr. McPhail to come out to Palo Alto, actually Cupertino at the time, and we hosted a day at HP where we brought a whole host of functions that quite frankly had never been in the same room talking about this topic. And first of all made sure that everybody was educated on NACME and what our objective was, and then just listened to many different functions and said, ok where does this fit into your charter? And that included what you probably would think of as the usual suspects, the diversity inclusion teams, the staffing organizations within HR, and that was certainly incredibly important to those groups. But it also included cross government affairs because actually there is a very strong policy link here that’s very important to a company like HP. We also included our procurement and supplier management teams. What is HP’s role and objective as we go out and spend tens of billions of dollars with other companies in procurement processes? What do we want to uphold in terms of a brand standard for those contracts that we award? Because you’re in a great position of power when you spend tens of billions of dollars and you award that through RFP’s, so what do we want to do there? And then we also included our talent and leadership management team.

We develop generations of leaders at HP. We have a robust process around succession strategies and plans and one of the things that you want to do when you develop leaders is not just develop their skills in the jobs they may do at HP, but you want to develop their leadership personas and their community persona. So, we have at HP a big commitment to community involvement, engagement and development, and as we look at our key talent around the organization we try to build leadership programs that allow them to engage in non-profit work or in community work. Well, in a company as large as HP [with] $120 billion, these things often happen in just a very disconnected way. And our objective by spending a day with Dr. McPhail was to try to say, if you want to do that, and if NACME has 84 Academies of Engineering around the country that NACME sponsors and participates with, why don’t we intersect HP’s leadership development program with those 84 Academies of Engineering? Which, by the way, is exactly what we’ve done. So, that’s just one of many examples. But what we then did is took these two objectives, again both viable and philanthropic in social innovation of what is HP’s commitment to this. Even if we weren’t thinking about the HP corporate
agenda, we live in the world, we live in the U.S. and we need to support causes that matter to both of those ecosystems.

You see [in Figure 1] that on the left and then business imperatives are on the right and what we did is mapped our initiatives to one box on the other, and it was completely fair game to have an initiative that straddled the boxes. And this made it very tangible for us. What we’re in the process of doing now is putting a scorecard around each of those and I’ll show you two examples. This is an example of building a diverse workforce and you see a summary of the initiatives. You see the group within HP that owns the initiative, in this case it’s the staffing organization that’s logical and on the right you see the matrix that we’re putting around this initiative. Specifically with respect to, in this case, our engagement with NACME as supporting this initiative. This is an example of the initiative with our supplier diversity program. What are we going to do as we award tens of billions of dollars of contracts? What are we going to expect from our suppliers in terms of their support of this initiative? And you see the same thing in this case, it’s buyers’ diversity that owns it. They sit within the procurement team and you see the metrics on the right. We now have a NACME steering committee that met pretty regularly as we were developing the scorecard. Actually, we met regularly as we were developing the initiatives and then met very regularly as we were developing the scorecard, and now we think we’ll meet quarterly. And this is actually our scorecard, our emerging scorecard and every quarter we’ll go through this and the organizations that own a metric as you see listed on the left. And everybody will sit through this meeting or this call so we can continue to look for ways to connect this together across HP and ways in which we can obviously as a NACME Board Member and a member of the Development Committee, our objective is also to help NACME institutionalize this for other board companies, because we think it makes the board membership engagement with NACME [better]; it takes it to a new level. And that, we think, will ultimately benefit the entire topic of STEM, as well as underrepresented minorities within STEM. So with that, thank you very much and I’ll turn it over to Mary.
Building STEM Education Pathways for Underrepresented Minorities

Panelist
Mary Wright
Program Director
Building Economic Opportunity
Jobs for the Future

Abstract
Today, community colleges are becoming an increasingly important entry point to higher education and STEM careers for underrepresented minorities. Yet too often, critical information about careers, employment, and earnings is detached from curriculum and programs of study. Jobs for the Future works directly with community college leaders to increase underrepresented minority participation in STEM education and careers by designing and driving the adoption of policies and programs that integrate real-time labor market information into programs of study and counseling. Jobs for the Future encourages policymakers to support policies and initiatives that enable community colleges to harness real-time labor market information and better prepare underrepresented minorities for rewarding STEM credentials and careers.

Background and Problem About Jobs for the Future
Jobs for the Future (JFF) works with our partners to design and drive the adoption of education and career pathways leading from college readiness to career advancement for those struggling to succeed in today’s economy.

JFF improves the pathways leading from high school to college to family-sustaining careers. Combining research, practice, and policy, JFF provides a unifying voice advocating for the transformation of the education and workforce development fields.

JFF’s Work to Increase Underrepresented Minorities in the STEM Workforce
Preparing for College and Careers: JFF’s Early College Design Services implement programs and models that enable underrepresented, minority students to earn up to two years’ worth of college credit, including in STEM degree programs, while still in high school—tuition free. As part of the Early College High School Initiative, JFF helped start or redesign 246 schools currently serving over 75,000 students.

Earning Postsecondary Credentials: JFF is one of the seven founding partners behind Achieving the Dream, a national initiative dedicated to helping more community college students—particularly underrepresented minorities (URMs)—stay in school and earn a college certificate or degree. Working with 130 community colleges to develop and implement strategies to improve student success, JFF leads the state policy strand, involving 16 states. Further, JFF’s Accelerating Opportunity and Breaking Through initiatives have created over 100 career pathways in community colleges across the country that help lower-skilled students earn credentials with value in the labor market.

Advancing Careers: The Greenforce Initiative, in partnership with the National Wildlife Federation, is helping over 8,000 lower-skilled and other nontraditional workers gain the education, training and experience needed to succeed in environment-related careers. The GreenWays initiative provides high-quality workforce services to employers and workers seeking to advance their careers in the green economy. The initiative invests in 20 workforce partnerships across six diverse industry sectors.

Challenges Facing URM Participation in the STEM Workforce
The Shortage of URMs in Science, Technology, Engineering, and Math (STEM) Careers: The STEM workforce plays an essential role to ensure that the United States remains competitive in an increasingly dynamic global economy. Yet this important sector of our national economy continues to face a seemingly intractable barrier—minority groups remain significantly underrepresented in STEM careers and too few are afforded opportunities to enter the pipeline.

In 2006, four Democratic U.S. Senators urged the National Academy of Sciences to conduct a formal study of this growing trend, which resulted in the 2011 report, Expanding Underrepresented Minority Participation: America’s Science and Technology Talent at the Crossroads. This landmark report found that URMs comprised 28.5 percent of the U.S. population in 2006, yet just 9.1 percent of college-educated individuals in science and engineering occupations. In order to match their share of the overall population, the proportion of URMs in STEM careers would need to triple. As the most rapidly growing segment of the population, URMs will be essential to meet the increasing demand for STEM expertise.

The Importance and Challenges of Community Colleges: According to a 2013 National Science Foundation report, URMs enroll in disproportionately higher numbers in public two-year colleges. Due
to open admission, affordable tuition, flexible scheduling, small class sizes, and childcare, community colleges have long been the institution of choice for women, URMs, and nontraditional students, especially those who are from low socio-economic family backgrounds.

With about 50 percent of college students starting their postsecondary education at two-year public institutions, community colleges are well recognized as a major entry point into higher education. According to the National Science Foundation, 61 percent of American Indian/Alaska Native, 53 percent of Hispanic, and 51 percent African American recipients of bachelor's and master's degrees in the sciences and engineering are graduates of two-year colleges that guide the use of labor market information to identify high-demand career pathways and associated postsecondary programs—or “best bets.” It features training with customized, ready-to-use tools and resources for supporting teams of senior staff and counselors through a process to identify and package information about best bets for use by students.

Counseling to Careers is serving as the broker of data to improve information, and utilize real-time LMI as an honest broker of data to improve information, counseling, and outreach so that URMs are sufficiently aware of and prepared for STEM career pathways. With the right information at the right time, URMs will be better prepared to acquire the technical training that will ultimately increase the number of URMs in the American STEM workforce. JFF advocates for state and federal policies to ensure that colleges incorporate LMI into course design, counseling, and curriculum:

1. Competitive grant funding (innovation and program improvement grants) for community colleges to support LMI integration in program design, curriculum, and counseling
2. Funding for federal grant and student loan programs should be contingent upon colleges’ demonstration of cost-effective approaches to LMI integration

In this way, LMI becomes a tool to help make data-based decisions that benefit students, educators and employers.

References


JFF’s Promising Practices and Solutions

Early College Design Services works with five early college STEM high schools in Chicago that focus on information technology. CISCO, IBM, Microsoft, Motorola, and Verizon each sponsor one of the schools. JFF provides school planning and professional development for this Chicago Public Schools partnership with the City Colleges of Chicago.

Counseling to Careers provides districts, community-based organizations, schools, and community colleges with the tools to better connect students with programs of study that align with their interests and regional employment needs. Counseling to Careers is serving as the critical link to help students choose the right postsecondary programs through a four-month engagement with community colleges that guides the use of labor market information to identify high-demand career pathways and associated postsecondary programs—or “best bets.” It features training with customized, ready-to-use tools and resources for supporting teams of senior staff and counselors through a process to identify and package information about best bets for use by students.

Call To Action

Too often, critical information about careers, employment, and earnings is detached from curriculum and programs of study. Career planning offices are usually the bearers of this information, which is mostly looked at after completing the course of program of study. More intensive efforts must be made to integrate labor market information into curriculum and programs of study. As students gain the knowledge and mastery of the subject, they also master the realities of the labor market where this subject is relevant. Community colleges should better access...


12. Ibid. 9.


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We engineer opportunity for minorities in STEM.

Our Mission
To ensure American competitiveness in a flat world by leading and supporting the national effort to expand U.S. capability through increasing the number of successful African American, American Indian, and Latino young women and men in science, technology, engineering, and mathematics (STEM) education and careers.

Our Vision
An engineering workforce that looks like America.

Our Belief
Diversity drives innovation.

Our Purpose
Through partnerships with like-minded entities, we serve as a catalyst to increase the proportion of African American, American Indian, and Latino young women and men in STEM careers. We inspire and encourage excellence in engineering education and career development toward achieving a diverse and dynamic American workforce.

Shaping an American STEM workforce where diversity drives innovation and global competitiveness

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