Report on the
Mentoring Workshop for Underrepresented Minority Undergraduate Engineering Students and Faculty/Staff Advisors
Baltimore, Maryland
November 13-14, 2009

Conducted by the
Quality Education for Minorities (QEM) Network

Supported by
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EXECUTIVE SUMMARY

OVERVIEW

With support from NSF's Directorate for Engineering, QEM Network conducted a two-day workshop focused on the mentoring and professional development of underrepresented minority Engineering students. The workshop's goal was to increase the participants' understanding of the roles that faculty and peer mentoring can play in enhancing the academic and professional outcomes of undergraduate engineering majors who are members of underrepresented minority groups. At the workshop, held November 13-14, 2009, in Baltimore, MD, students and their faculty mentors/advisors were provided opportunities to share mentoring experiences and best practices, learn about effective mentoring, and develop a peer support network. Workshop sessions were designed to:

(1) provide information, resources, and strategies to assist faculty in mentoring and supporting the professional development of engineering students; and

(2) provide students with information and other resources to support their retention in engineering as they move through the undergraduate/graduate years and pursue professional engineering careers upon graduation.

The target audiences for the workshop were 150 underrepresented students and 15 faculty advisors from 15 institutions with ABET-accredited engineering programs (seven Historically Black Colleges and Universities, five Hispanic-serving Institutions, one Other Minority Institution, and two Predominantly White Institutions). A ten-person team of underrepresented minority undergraduate engineering students and an engineering faculty/ advisor were invited to attend from each of the following institutions.

- California State University, Los Angeles
- Florida A&M University-Florida State University
- Florida International University
- Georgia Institute of Technology
- Howard University
- Massachusetts Institute of Technology
- Morgan State University
- New Mexico State University
- North Carolina A&T State University
- Prairie View A&M University
- Tennessee State University
- The City College of New York
- The University of Texas at El Paso
- Tuskegee University
- University of Puerto Rico at Mayaguez

The participating students were selected by the faculty advisor, using the selection criteria described below. The advisors included engineering faculty members and staff with interest, experience, and success in mentoring undergraduate engineering students, particularly underrepresented minorities.

Student Selection Criteria

- Must be a member of a minority group underrepresented in Engineering (African American, American Indian, Alaska Native, Mexican American, or Puerto Rican)
- Must be in good academic standing at his/her institution with an overall as well as a major field Grade Point Average (GPA) of at least 2.5 on a 4.0 scale.

Student participants included 142 engineering majors (sophomores, juniors, and seniors), 74 females and 68 males, representing all 15 institutions. Eighteen (18) faculty/staff advisors, at least one per institution, accompanied the student teams. Twenty-two (22) speakers and presenters, including 5 NSF program officers and 8 QEM staff and consultants, participated in workshop sessions.

The workshop featured speakers, panelists, consultants, and staff who discussed the following topics in plenary and concurrent sessions.

- Applying to Graduate School and Financing a STEM Education
- Broadening Participation in Engineering at NSF
- Characteristics of Mentoring
- Developing Early Research Plans
- Engineering Achievements in Today's Society
- Mentoring Models for Success
- Minority Participation in Engineering Careers
- Preparing Students to Meet Tomorrow's Challenges in Engineering: Competing on a Global Scale; and Entrepreneurship
- Modeling and Fostering Professional Conduct (Ethics and Scholarly Productivity)
- Preparing Undergraduate Engineering Majors to Meet Academic and Professional Expectations
- Views on Mentoring -What Works: Faculty and Students' Perspectives
- What Research Tells Us About Mentoring

Faculty development breakout sessions focused on *Preparing and Supporting Students to Meet Academic Expectations;* and *Best Practices in Mentoring and Advising Engineering Students*. Student development breakout sessions (organized by academic level-sophomores, juniors, seniors) focused on *Meeting Academic and Professional Expectations: Preparing Individual Mentoring and Academic/Career Plans (IMAPs);* and *Developing Personal and Professional Skill Sets*. A copy of the Agenda for the workshop is given at **Appendix A**, and brief biosketches of presenters external to QEM and NSF are provided at **Appendix B**.

SUMMARY OF KEY POINTS FROM THE WORKSHOP SESSIONS

Characteristics of Mentoring

Speakers and panelists identified the following attributes of mentoring:

- Giving support in a non-threatening manner
- One person helping another to achieve a desired outcome
- One-to-one relationship that is completely confidential
- The process of one person sharing, giving a bit of essence of himself/herself to another person so that person might grow closer to what he/she is capable of becoming
- The process of leading, guiding, keeping interest alive, supporting, counseling, teaching, coaching, demonstrating, and challenging, within a relationship of mutual trust and respect

- Taking another under one's wings and allowing him/her a nurturing place to develop his/her own wings and a flight plan
- The process in which two or more individuals share a vision to achieve mutual growth and development

What Research Tells Us About Mentoring

Students were advised that research indicates that their mentors need not share their gender or race/ethnicity to be effective. Other research findings indicated that:

- Faculty attitudes and pedagogical practices are critical to students' cognitive and affective development
- The way in which individuals construct and use their knowledge is directly tied to their sense of self
- Student-faculty relationships and peer friendships exert powerful influence on student development
- Students with same-ethnic mentors perceived them to be significantly more supportive in furthering their personal and career development and reported significantly greater program satisfaction than non-matched students
- Frequency of student-mentor contact is positively correlated with students' adjustment to college, perceived mentor supportiveness, and program satisfaction

Research also suggests that mentoring from a variety of sources and improved faculty/student interaction are important to students' persistence in engineering. An additional observation was that younger faculty tend to spend more time with students than older faculty.

Research findings indicate that effective mentoring outcomes for students include positive attitudes, greater effort, better time management, greater resilience, and lower stress and anxiety. Other findings suggest that what matters for college students are academic confidence, opportunities to engage encouraging faculty on a personal level, and greater campus involvement.

Minority Participation in Graduate School and Engineering Careers

- African Americans, Latinos, and American Indians are about 30% of the overall undergraduate population in the U.S., but receive only about 12% of the degrees awarded in engineering
- Of the 68,000 bachelor's degrees in engineering awarded in the U.S. in 2006, 8,500 were to underrepresented minorities
- Of the 6,404 Ph.D. degrees in engineering awarded in 2006, 100 went to African Americans, 98 went to Latinos, and 9 went to American Indians/Alaska Natives
- Employment in Science and Engineering (S&E) occupations will increase at about twice the growth rate for all occupations through 2014

Students were strongly encouraged by many of the presenters to pursue advanced degrees in engineering fields. They were provided information on potential resources for graduate education support, including the NSF Graduate Research Fellowships (GRF) and the National Consortium for Graduate Degrees for Minorities in Engineering and Science, Inc. (GEM).

Students were encouraged to pursue various career options, including jobs in academia and government. It also was pointed out to students that the world is looking for "gold collar workers" who can compete in science and engineering on a global scale. Networking was stressed as a powerful tool in pursuing an engineering career, and students were told to network and be actively involved in professional science and engineering organizations to be globally competitive.

One speaker provided the following tips to use in preparing for an industry position:

- Secure an internship and/or co-op position
- Establish a broad network
- Prepare a corporate resume including all experiences and clear objectives
- Become involved with community service/outreach
- Demonstrate leadership capabilities
- Secure any required licensing (certifications)
- Demonstrate excellent communication skills

Entrepreneurship was presented as another career option for engineering graduates. It was noted that venture capitalists who focus their investments in minority enterprises currently do not concentrate heavily in high technology firms that require engineering expertise. Students were encouraged to change this paradigm.

Faculty and students were made aware of the opportunities in engineering research and education supported by NSF. Participants were urged to discuss these opportunities with their colleagues following the return to their respective campuses.

Scholarly Productivity

To maximize undergraduate research and scholarly productivity, it was suggested that students develop a four-year research opportunity plan, beginning in the freshman year. The plan would help prepare the student to be a competitive candidate for graduate school. One panelist observed that professional conduct involves ethical conduct which includes honesty, following the "Golden Rule," responsible behavior, fairness, and compassion. Also discussed were workplace ethics that include the personal use of the Internet, the e-mail system, the telephone, or other office equipment.

Faculty Development

Faculty development breakout sessions focused on *Preparing and Supporting Students to Meet Academic Expectations*. One faculty session focused on:

- Preparing Undergraduate Students to Meet Academic Expectations
- Mentoring/Supporting Engineering Students with Special Needs
- Promising Practices in Advising and Mentoring Engineering Students

It was suggested that a Continuous Undergraduate Research Experience (CURE) be considered by the participating institutions to provide freshmen and sophomores with a

persistent and comprehensive undergraduate research experience. The goal of the effort would be to develop a focused interdisciplinary research infrastructure based primarily on undergraduate students.

Engineering Achievements

The closing session focused on the greatest engineering achievements of the 20th Century and the grand challenges for engineering in the 21st Century. The impact of these achievements on society and students' current role in meeting the challenges of the future for the betterment of society was discussed. The speaker summarized the following characterizations of engineers:

- Engineers have made a difference in the world; we like to call them scavengers. They create things that have never been.
- Engineers are paid fairly well in this society, and there continues to be a shortage of engineers in the U.S., which is a negative drag on the economy.
- Engineering is critical to societal advancement.

An Engineering Design Competition held in the evening on the first day of the workshop provided an opportunity for the students to work together while getting to know their peers. The students were grouped into cross-institutional teams to develop/assemble a series of five *PBS Design Squad* projects for competition, with materials and guidance provided by QEM. The faculty advisors served as judges during the competition.

The instructions for the hands-on projects, which contextualize engineering concepts and provide an opportunity to teach younger students about the links between engineering and daily life, were retrieved from the *Design Squad* website, the online companion to a television series airing on PBS Kids. The projects were examples of outreach activities that undergraduates could conduct with K-12 students. The engineering students were strongly encouraged to serve as near peer mentors and share their experiences with younger students to help motivate them towards engineering careers.

EVALUATION AND RECOMMENDATIONS

The overwhelming majority of the students said the workshop achieved its overall purpose. Several made specific comments regarding how the workshop, including specific breakout sessions and specific speakers, had given them a clearer understanding of what they needed to do to successfully complete their undergraduate work. They were particularly appreciative of the information provided during the plenary sessions on funding opportunities available to them. Many commented that they had a greater appreciation for the importance of obtaining advanced degrees in engineering to their long-term success.

Evaluation:

Based on the QEM Evaluation Questionnaire completed at the end of the workshop, 84.7 percent of the faculty respondents and 91.7 percent of the student respondents rated the Workshop as excellent or very good. The students gave the highest rating of most helpful sessions to the "Concurrent Breakout Sessions" in which they separated into groups by academic level (sophomores, juniors, and seniors) to discuss various topics related to mentoring led by QEM staff and consultants.

They ranked the helpfulness of other sessions in the order listed below:

(2) "Applying to Graduate School and Financing a STEM Graduate Education"
(3) "Engineering Design Competition"
(4) "Preparing Students to Meet Tomorrow's Challenges in Engineering"
(5) "Mentoring: Models for Success"

The sessions rated least helpful by the students were "Entrepreneurship" and "Modeling and Fostering Professional Conduct."

Eleven (11) or 84.6 percent of the faculty respondents indicated that the workshop met their expectations. All of the faculty respondents rated the sessions on "Mentoring: Models for Success and "Engineering Achievements in Today's Society" as excellent or very good. Seventy-seven (77) percent of the faculty rated the session on "Views on Mentoring Students-Students' Perspectives" as excellent or very good.

A concern expressed by students and faculty was that the workshop included too many back-to-back lectures that took away from the effectiveness of the messages. Another point made by several students was that the first day was too long. Some suggested that more breaks be provided between sessions and that more time be allowed for students to interact with each other. It also was suggested that workshop sessions with specific topics be included that would allow participants to pick and choose those they believed were relevant to their needs. Some faculty noted that the university teams should have met at some point during the two days to generate campus follow-up plans.

<u>Recommendations</u>

- Hold another engineering mentoring workshop next year, modified using feedback received from students and faculty participants at the first workshop. Plans for the workshop agenda should incorporate advice from undergraduate engineering students and from faculty who mentor these students. The next workshop should enhance the opportunities for student-student and faculty-faculty interactions regarding mentoring of undergraduates.

- Continue and strengthen small breakout group discussions on various topics related to mentoring. In the next workshop, allow students to choose sessions they believe are relevant to them as well as sessions that separate students by academic level (sophomores, juniors, and seniors).

- Allow more time for participating institutions to share "what works" regarding the mentoring of undergraduate underrepresented engineering majors.

- Increase focus on mentoring/supporting engineering students with special needs.

- Package the materials used in the Engineering Design Competition prior to the workshop to facilitate the flow of and minimize the time students spend on this activity.

NEXT STEPS

Individual Mentoring and Academic/Career Plans (IMAPs) completed by the students during the workshop were submitted to QEM. They are being reviewed by QEM staff who will then follow-up with students on their progress in meeting their outlined goals and objectives. A copy of the IMAP template is provided at **Appendix C**. The participants are expected to share the experiences and information they received with their campus colleagues.

To facilitate this process, all presentations were linked to the workshop agenda at QEM's website (http://qemnetwork.qem.org/QEM_ENGMentoringWkshpAgendaFinal.htm). Students and their advisors were encouraged to take the time to review the workshop information packet and CD of resources and also to share the presentations with other students and faculty in their respective departments.

The IMAPs completed by the students during the workshop and submitted to QEM were duplicated and returned to the students by mail in sealed envelopes. Students were asked to share the IMAPs with the mentors they identified on the forms and to continue to update their IMAPs. QEM will follow-up with the students in February 2010 and June 2010 to get formal updates on their progress in achieving the goals outlined in their IMAPs.

In response to participant feedback about the need for the increased involvement of senior faculty on campus in the retention and mentoring of engineering students, QEM will explore the possibility of a follow-up workshop focused on senior engineering faculty and senior engineering administrators.

The workshop provided an opportunity for students to meet and interact with peers from across the country with similar interests and aspirations. They also met outstanding mentors in a range of careers with whom they discussed pathways to academic and professional success. Students were encouraged to further develop and maintain the peer network of contacts across the participating institutions as well as mentor/reach out to younger students. Effective mentoring will lead to an increase in the number of minority students who obtain baccalaureate and doctoral degrees in engineering, thus strengthening the nation's global competitiveness in science and technology.

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DETAILS OF REPORT

OVERVIEW

QEM received support from the Directorate for Engineering at the National Science Foundation to conduct a two-day workshop focused on the mentoring and professional development of underrepresented minority Engineering students. The workshop's goal was to increase the participants' understanding of the roles that faculty and peer mentoring can play in enhancing the academic and professional outcomes of undergraduate engineering majors who are members of underrepresented minority groups. The target audiences for the workshop were 150 underrepresented students (15 ten-person teams) and 15 faculty advisors from 15 institutions with ABET-accredited engineering programs Attending the workshop were representatives of seven Historically Black Colleges and Universities, five Hispanic-serving Institutions, one Other Minority Institution, and two Predominantly White Institutions.

The participating students were selected by the faculty advisor, using the selection criteria described below. The advisors included engineering faculty members and staff with interest, experience, and success in mentoring undergraduate engineering students, particularly underrepresented minorities.

Student Selection Criteria

- Must be a member of a minority group underrepresented in Engineering (African American, American Indian, Alaska Native, Mexican American, or Puerto Rican)
- Must be in good academic standing at his/her institution with an overall as well as a major field Grade Point Average (GPA) of at least 2.5 on a 4.0 scale.

The mentoring workshop was held on November 13-14, 2009, in Baltimore, MD. The workshop student participants consisted of 142 engineering majors (sophomores, juniors, and seniors), 74 females and 68 males, representing all 15 invited institutions. Eighteen (18) faculty/staff advisors, at least one per institution, accompanied the student teams. A list of the participating institutions is given below.

- California State University, Los Angeles
- Florida A&M University-Florida State University
- Florida International University
- Georgia Institute of Technology
- Howard University
- Massachusetts Institute of Technology
- Morgan State University
- New Mexico State University
- North Carolina A&T State University
- Prairie View A&M University
- Tennessee State University
- The City College of New York
- The University of Texas at El Paso
- Tuskegee University
- University of Puerto Rico at Mayaguez

Workshop sessions were designed to:

(1) provide information, resources, and strategies to assist faculty in mentoring and supporting the professional development of engineering students; and

(2) provide students with information and other resources to support their retention in engineering as they move through the undergraduate/graduate years and pursue professional engineering careers upon graduation.

The two-day workshop featured speakers, panelists, and consultants as well as NSF and QEM staff who discussed the following topics in plenary and concurrent sessions:

▪ Applying to Graduate School and Financing a STEM Education ▪ Broadening Participation in Engineering at NSF ▪ Characteristics of Mentoring ▪ Developing Early Research Plans ▪ Engineering Achievements in Today's Society ▪ Entrepreneurship ▪ Mentoring Models for Success ▪ Minority Participation in Engineering Careers ▪ Peer Mentoring	▪ Preparing Students to Meet Tomorrow's Challenges in Engineering: Competing on a Global Scale ▪ Modeling and Fostering Professional Conduct (Ethics and Scholarly Productivity) ▪ Preparing Undergraduate Engineering Majors to Meet Academic and Professional Expectations ▪ Views on Mentoring – What Works: Faculty and Students' Perspectives ▪ What Research Tells Us About Mentoring

Faculty development breakout sessions focused on *Preparing and Supporting Students to Meet Academic Expectations*. Student development breakout sessions (organized by academic level-sophomores, juniors, seniors) focused on *Meeting Academic and Professional Expectations: Developing Individual Mentoring and Academic/Career Plans (IMAPs) and Personal and Professional Skill Sets*. A copy of the Agenda for the workshop is given at **Appendix A**. Twenty-two (22) speakers and presenters, including 5 NSF program officers and 8 QEM staff and consultants, participated in the workshop sessions. Brief biosketches of presenters external to QEM and NSF are provided at **Appendix B**.

DETAILED SESSION HIGHLIGHTS

A summary of key points and recommendations made during each workshop session follows. The order of the topics mirrors the agenda.

DAY ONE	Faculty Development Session A
Opening Session	Dinner Session
What Research Tells Us About Successful Mentoring	Engineering Design Competition
Career Pathways in Engineering	**DAY TWO**
Concurrent Breakout Sessions I	Mentoring Models for Success
Luncheon Session	Student Panel
Modeling and Fostering Professional Conduct	Faculty Panel
Applying to Graduate School/Financing a STEM Education	Concurrent Breakout Sessions III
Entrepreneurship	Faculty Development Session B
Concurrent Breakout Sessions II	Closing Luncheon Session

Workshop presentations have been linked to the respective presenter's name on the agenda at QEM's website (http://qemnetwork.qem.org/QEM_ENGMentoringWkshpAgendaFinal.htm). The presentations also can be downloaded to facilitate sharing by participants.

FRIDAY, NOVEMBER 13, 2009

Opening Session

The participants were welcomed to the workshop by Dr. Omnia El-Hakim, Program Director for Diversity and Outreach, Directorate for Engineering, National Science Foundation; and Dr. Shirley McBay, President of QEM Network. Following the welcome and brief introductions, Dr. McBay reviewed the two-day agenda with the participants.

Keynote Speaker: Dr. Percy Pierre, Professor of Electrical and Computer Engineering, Michigan State University and NACME Co-Founder

In discussing "what is mentoring," Dr. Pierre stated that:

- Mentoring is about giving support in a non-threatening manner
- About one person helping another to achieve a desired outcome
- An exclusive, one-to-one, completely confidential relationship

He said that some individuals might need multiple mentors and that a mentor need not be a role model. Dr. Pierre advised the students that, in most cases, they would not be assigned a mentor; they would have to find one. In selecting a mentor, he urged the students to "choose someone who has achieved what you want to achieve and someone in a position to assist you in attaining your goals."

Dr. Pierre further advised the students to prepare themselves for multiple engineering career paths as well as advanced degrees. He noted that graduate school attendance gives one more career options. Dr. Pierre then gave a number of examples of successful individuals for whom he had served as a mentor throughout his career paths in both higher education and government. He encouraged the students to seek, and be open to, multiple mentors.

Panel on "What Research Tells Us About Successful Mentoring of Undergraduate Engineering Students"

Dr. Lorelle Espinosa, Director, Policy and Strategic Initiatives, Institute for Higher Education Policy (IHEP):

Dr. Espinosa spoke about the many forms that mentoring takes. She pointed out that men and women of color can tap into a host of networks that include professors, graduate students, other undergraduates, university administrators, and professionals in and outside of their major field. She advised participants that mentors need not share the same gender and racial/ethnic backgrounds as the students they support and that mentoring has a major impact on how students develop their sense of self in college.

Dr. Espinosa discussed research she conducted on the role of self-perception/concept in college student development and made the following observations:

- Faculty attitudes and pedagogical practices are critical to students' cognitive and affective development
- The way in which individuals construct and use their knowledge is directly tied to their sense of self
- Development of students' competence contributes to their psychosocial development during college
- Student-faculty relationships and peer friendships exert powerful influences on student development

Ms. Susan Staffin Metz, Senior Advisor, Center for Innovation in Engineering and Science Education, Stevens Institute of Technology

Ms. Metz discussed a recent NSF award for which she is serving as Principal Investigator. The project, entitled *Engaging Students in Engineering* (ENGAGE), focuses on ways to improve the retention of undergraduate engineering students, particularly women. The project's research strategy is designed to improve faculty-student interaction and mentoring as well as implement strategies that research indicates improve student retention in Engineering.

Ms. Metz shared the results of a MentorNet survey that focused on student perceptions on mentoring and three mentoring roles (psychosocial, role modeling, and academic/career). She noted that undergraduate underrepresented minorities were more likely to consider all three mentoring roles important than students from other racial/ethnic groups. She also stated that the research suggests the following:

- Mentoring from a variety of sources is important to students' persistence in engineering
- Improved faculty/student interaction is important to students' persistence in engineering
- Mentoring is a shared responsibility among the faculty, the student, and the Engineering School

She also stated that younger faculty tend to spend more time with students than older faculty. Additional research findings shared during the session include the following questions and answers:

Why does "mentoring" impact academic persistence?
- Affects student self-efficacy (A person's perception of his/her ability to reach a goal)

How does self-efficacy differ from self-confidence?
- Self-efficacy is "domain specific."

What affects self-efficacy and what can be done? What can faculty do?
- Interact with students in and out of the classroom
- Maintain a positive classroom climate
- Avoid negative or intimidating messages
- Be approachable and encourage students

Panel on Career Pathways in Engineering

Dr. Garrick Louis, Associate Professor, Department of Systems and Information Engineering, University of Virginia

Dr. Louis discussed statistics related to the participation of underrepresented minority groups in engineering. He presented the following data:

- The percent of bachelor's degrees in engineering awarded to African American students declined from 3.3% in 1995 to 2.5% in 2005
- African Americans, Latinos, and American Indians are about 30% of the overall undergraduate population in the U.S., but receive only about 12% of the degrees awarded in engineering
- Of the 68,000 bachelor's degrees in engineering awarded in the U.S. in 2006, 8,500 were to underrepresented minorities
- Of the 6,404 Ph.D. degrees in engineering awarded in 2006, 100 went to African Americans, 98 went to Latinos, and 9 went to American Indians/Alaska Natives
- Women of all ethnic backgrounds account for less than 20% of the engineering degree recipients at every level
- Employment in Science and Engineering (S&E) occupations will increase at about twice the growth rate for all occupations through 2014, with 73% of the projected increase being in computer-related jobs

Dr. Louis remarked that the current trends in degree production and employment should encourage more individuals to pursue engineering degrees.

Dr. Stephanie Adams, Associate Dean for Undergraduate Studies and Associate Professor, Department of Mechanical Engineering, School of Engineering,
Virginia Commonwealth University

Dr. Adams discussed engineering careers in industry and government. She provided student participants with the following tips for preparing for an industry position:

- Secure an internship and/or co-op position
- As a student, establish a broad network
- Prepare a corporate resumé that includes all experiences and clear objectives
- Become involved with community service/outreach
- Demonstrate leadership capabilities
- Secure any required licensing/certifications
- Demonstrate excellent communication skills

Dr. Adams also told participants that industry employee/staff responsibilities generally are broken out as follows: management-45%; technical research-45%; and service-10%. She also described typical roles in each category and related levels of education or advanced degrees.

Concurrent Breakout Sessions – Part I

The students participated in concurrent breakout sessions led by QEM senior staff and consultants, grouped by academic level (sophomores, juniors, or seniors). The general topic of the sessions was *Preparing Undergraduate Engineering Majors to Meet Academic Expectations: Developing Individual Mentoring and Academic/Career Plans (IMAPs).* A copy of the IMAP template is provided at **Appendix C.**

- Sophomores discussed: "Academic Requirements and Course Timetables; and Building Effective Study Habits"
- Juniors discussed: "Graduate School Planning-Test Preparation; and Personal Profile Development"
- Seniors discussed: "Mentoring Younger Students; Graduate School Planning; and Portfolio and Personal Profile Development"

In the session for sophomores, led by Dr. Garrick Louis, Consultant, and Dr. Costello Brown, QEM Senior Associate, students also discussed goal-setting, choosing mentors, and sharing knowledge. In the session for juniors, led by Dr. Stephanie Adams, Consultant, and Dr. J. Arthur Jones, QEM Senior Associate, students also drafted personal vision and mission statements, and identified needs for creating support networks. In the session for seniors, led by Dr. Brian Blake, Consultant, and Ms. Laura-Lee Davidson, QEM Associate, the students also discussed procedures and timelines for graduate school planning as well as tips for networking with faculty and potential recommenders.

Faculty advisors and several presenters participated in the student breakout sessions. In all of the sessions, the importance of peer mentoring and mentoring younger students was emphasized as was the importance of teamwork and career/research experiences.

Luncheon Session-Preparing Students to Meet Tomorrow's Challenges in Engineering

Keynote Speaker: Dr. Victor McCrary, Business Area Executive, Science and Technology, The Johns Hopkins University Applied Physics Laboratory and President, National Organization of Black Chemists and Chemical Engineers (NOBCChe)

Dr. McCrary emphasized to the participants that many opportunities are interdisciplinary and that it is important to understand how to become a *transboundary* navigator. He stressed that the world is looking now for "gold collar workers," who can compete on a global scale. He encouraged the students to read Thomas Friedman's book *The World is Flat* to get a broader understanding of this topic. Dr. McCrary emphasized the power of networking in pursuing a career. He mentioned the importance of belonging to, and being actively involved in, a "club" that provides informal and formal connections such as membership and participation in professional science or engineering organizations.

Session on Modeling and Fostering Professional Conduct

Dr. Rose Wesson, Program Director, Division of Chemical, Bioengineering, Environmental, and Transport Systems, Directorate for Engineering, National Science Foundation

Dr. Wesson discussed professional ethics, conduct, and workplace behavior. She pointed out that standards of ethical conduct include:

- Honesty
- Following the "Golden Rule"
- Responsible Behavior
- Fairness
- Compassion

Dr. Wesson emphasized that the clothes one wears should always reflect his/her seriousness about the job as most people tend to "judge a book by its cover." She told the students that dressing appropriately in today's workplace is essential and that "you should dress for the job you want to have, not for the job you have." Dr. Wesson also discussed professional behavior in the workplace, including ethics in the personal use of the Internet, e-mail system, the telephone, and the office copy/fax machine. She recommended that the students develop a personal code of ethics (e.g., integrity, respecting others, and taking responsibility for one's actions) and provided tips/advice to avoid the abuse of workplace privileges and violation of the code.

Dr. Brian Blake, Professor of Computer Science and Associate Dean of Engineering for Strategic Initiatives, University of Notre Dame

Dr. Blake discussed ways to maximize undergraduate research and scholarly productivity. He recommended that students develop a four-year research opportunities plan, beginning in the freshman year. The plan would include identifying STEM-related opportunities; conducting literature searches; and team building. He remarked that students would have very little research in their first-year and stressed the importance of doing well in core STEM courses.

Dr. Blake emphasized the importance of graduate school planning and provided a profile of a competitive graduate school candidate. The profile included the following:

- A competitive GPA and GRE score
- Research or industry experience
- Courses that support one's ambition
- Extracurricular activities that support leadership and teaming ability
- Good rapport with faculty who can write the most compelling recommendation letters
- Clear communication skills, being confident and energetic
- A resumé and a personal statement that are clear and free of errors

He listed several key developmental milestones students should include in their research and graduate school planning.

Panel on Applying to Graduate School and Financing a STEM Graduate Education

Dr. Carmen Sidbury, Program Director, Division of Graduate Education, EHR Directorate, National Science Foundation

Dr. Sidbury focused her remarks on enabling young investigators. She described various fellowship programs at the Foundation, including:

- Graduate Research Fellowships (GRF) – Enriching Experiences for Individuals
- Graduate Teaching Fellows in K-12 Education (GK-12) – Career Advancement and Creating Novel Opportunities for Graduate and Pre-College Education
- Integrative Graduate Education and Research Traineeship Program (IGERT) – Promoting Innovation through Interdisciplinary Collaborations

She discussed the importance of graduate education and career advancement and then focused most of her presentation on the GRF Program. She reviewed the GRF history, program features, and eligibility criteria. Dr. Sidbury described the application submission process and NSF's review criteria as well as related assessment measures.

- *Intellectual Merit Review Criterion*
  "Demonstrated intellectual ability and other accepted requisites for scholarly scientific study, such as the ability to:(1) plan and conduct research; (2) work as a member of a team as well as independently; and (3)interpret and communicate research."

- *Broader Impacts Review Criterion*
  "Contributions that: (1) integrate research and education at all levels, infuse learning with discovery, and assure that the findings are communicated in a broad context and to a large audience; (2) encourage diversity, broaden opportunities, and enable the participation of all citizens, underrepresented minorities, and persons with disabilities -- in science and research; (3) enhance scientific and technical understanding; and (4) benefit society."

Dr. Sidbury also noted some of the achievements of GRF recipients - high rates of Ph.D. degree completion, shorter time to degree completion, high placement in faculty positions, high levels of research productivity, and more than 20 Nobel laureates.

Dr. A. James Hicks, Program Director, Alliances for Broadening Participation in STEM, Division of Human Resource Development, EHR Directorate, National Science Foundation

Dr. Hicks discussed the NSF Louis Stokes Alliances for Minority Participation (LSAMP) and the Bridge to the Doctorate Program. He stated that the aim of LSAMP is to increase the quantity and quality of students successfully completing STEM baccalaureate degree programs, and to increase the number of students interested in and matriculating into programs of graduate study.

Dr. Hicks emphasized that the long-term goal of the Program is to increase the number of students, particularly those from populations underrepresented in STEM fields, who earn doctorates in STEM. He described the components of the student retention model used by LSAMP and noted the program's geographic reach (45 institutions nationwide and 1,128 students). Dr. Hicks also presented profiles of Bridge to the Doctorate students at institutions in five states.

Ms. Michele Lezama, Executive Director, The National Consortium for Graduate Degrees for Minorities in Engineering and Science, Inc. (GEM)

Ms. Lezama discussed graduate school support opportunities provided through the National Consortium for Graduate Degrees for Minorities in Engineering and Science, Inc. (GEM). GEM focuses on increasing the participation of underrepresented minorities at the master's and doctoral levels in STEM. She informed the students that the industry- and university-sponsored GEM program provides full fellowships for graduate school as well as paid summer internships. She also stated that GEM conducts informational programs (GRAD Labs) on the application process and graduate school experience and also conducts a Future Faculty and Professionals Symposium.

Ms. Lezama described the fellowship requirements/eligibility criteria and noted that GEM received about 1,200 applications for the 125 fellowships being offered for the 2010 Program. She told the students that they should look at engineering as a career, not as just a job; that "passion" should outweigh "money"; and that they should be prepared for the varied opportunities an engineering career provides.

Session on Entrepreneurship

Dr. Juan Figueroa, Program Director, Small Business Innovation Research, Division of Industrial Innovation and Partnerships, Directorate for Engineering, NSF

Dr. Figueroa spoke to the participants on the topic "Entrepreneurship-Why Not Me?" and defined an entrepreneur as "a person who takes the risk of converting innovative ideas into profitable realities." He stated that entrepreneurs bear the risk of running a business but also have the opportunity to participate in the creation of wealth. Dr. Figueroa then listed the requirements of someone interested in becoming an entrepreneur – creativity, risk-taking, communication skills, and organization skills. He provided the following overview of entrepreneurship in the U.S.:

- Entrepreneurship is widespread and participation is more common that imagined
- About 6.2 in every 100 U.S. adults 18 years and older are engaged in trying to start new firms
- Education significantly predicts nascent entrepreneurship, particularly for Blacks and Hispanics
- Where people live affects entrepreneurial activity
- The impact of urban context (i.e., a county-level measure of certain economic, demographic and educational factors) varies for whites, Blacks, and Hispanics
- Venture capital investing in minority enterprises is very profitable.

Dr. Figueroa observed that venture capital firms that currently focus their investments on minority enterprises do not concentrate heavily in high technology firms. He encouraged the workshop participants to "start a new trend!"

Concurrent Breakout Sessions – Part II

The main topic was *Preparing Engineering Majors to Meet Academic Expectations: Skill Sets*.

- Sophomores discussed: "Resumé Development for Internships and Co-op Opportunities; Update of Individual Mentoring Plans; and Team-Building Strategies"
- Juniors discussed: "Resumé Development for External Research/Practice Opportunities; Research Experiences for Undergraduates (REU); and Update of Personal Profiles and Individual Mentoring Plans"
- Seniors discussed: "Portfolio and Personal Profile Development; Global Research Opportunities; International Research Experiences for Students; and Writing a Research Abstract"

Sophomores also discussed study groups and time management skills. Additional topics discussed by juniors included career planning and goal-setting. Seniors also discussed guidelines for communicating effectively in writing and tips for writing a persuasive essay.

A fourth breakout session, described below, was held for the faculty/staff advisors who accompanied the students to the workshop.

Faculty Development Session A

Dr. Alvin Kennedy, Chair, Department of Chemistry, Morgan State University

Dr. Kennedy led the faculty session focused on:

- Preparing Undergraduate Students to Meet Academic Expectations
- Mentoring/Supporting Engineering Students with Special Needs
- Best Practices in Advising and Mentoring Engineering Students

The participants discussed factors affecting freshman student success (e.g., high school-university transition, academic preparation, and career exposure) and the benefits of undergraduate research. Dr. Kennedy recommended that a Continuous Undergraduate Research Experience (CURE) be considered by institutions to provide freshmen and sophomores with a persistent and comprehensive undergraduate research experience. The goal of CURE would be to develop a focused interdisciplinary research infrastructure based primarily on undergraduate students. The elements of CURE would include a summer program focused on research and critical thinking skills development, and academic year activities (e.g., technical conference attendance, presentations, and networking). Dr. Kennedy outlined aspects of a critical thinking skills framework and the set of related activities.

Dr. Kennedy emphasized the importance of institutions setting policies and implementing practices/procedures to support students with special needs to enable their full participation, not just inclusion, in the pursuit of STEM careers. He stressed that faculty should work closely with individuals responsible for student support services to identify resources and effective strategies as well as assistive technology to help self-identified students with disabilities. The NSF Research on Disabilities Education (RDE) program, which supports regional alliances as well as the work of grantees with students with disabilities, was identified as a potential source of support/resource.

Dinner Session - Broadening Participation Opportunities in Engineering at the NSF

Dr. Omnia El-Hakim, Program Director of Diversity and Outreach, Directorate for Engineering, National Science Foundation (NSF)

Dr. El-Hakim provided information to participants on NSF's mission as well as on the mission of the Engineering Directorate. She presented demographic data on Engineering B.S. degrees granted from 1997-2007 and discussed the contributions that underrepresented groups bring to the Engineering as well as some of the challenges they face. Dr. El-Hakim highlighted various NSF funding opportunities designed to broaden participation in engineering, including:

- Broadening Research Initiation Grants in Engineering (BRIGE) – supports undertaking exploratory investigations, acquiring preliminary data, and developing collaborations
- Research to Aid Persons with Disabilities (RAPD) – supports research that will lead to the development of new technologies, devices, or software for persons with disabilities
- Increasing the Participation and Advancement of Women in Academic Science and Engineering Careers (ADVANCE)
- Graduate Research Fellowships for Women and Graduate Research supplements
- Research Experiences for Undergraduates (REU) – supports the involvement of undergraduates in meaningful ways in ongoing research programs or in research projects specifically-designed for the REU program
- Research Experiences for Teachers in Engineering – supports the active involvement of K-12 teachers and community college faculty in engineering research to bring knowledge of engineering and technological innovation into their classrooms
- Tribal College Initiative – to expand the engineering and pre-engineering capacities of tribal colleges and universities through curriculum development and partnerships

Dr. El-Hakim provided details on funding levels and eligibility requirements for several programs, including REU and the EHR/ENG Pre-engineering Education Collaboratives. She encouraged participants to discuss these and other opportunities –students with peers and mentors; faculty advisors with colleagues and department heads– upon their return to campus.

Post-Dinner Engineering Design Competition

An Engineering Design Competition held in the evening on the first day of the workshop provided an opportunity for the students to work together while getting to know their peers. The students were grouped into cross-institutional teams to develop/assemble a series of five *PBS Design Squad* projects for competition, with materials and guidance provided by QEM. Nine teams were formed, each with at least 15 students (one student from each institution), and charged with constructing at least three of the five projects.

The instructions for the hands-on projects, which contextualize engineering concepts and provide an opportunity to teach younger students about the links between engineering and daily life, were retrieved from the *Design Squad* website (http://pbskids.org/designsquad/), the online companion to a television series airing on PBS Kids. The projects were examples of outreach activities that undergraduates could conduct with K-12 students.

The projects constructed were: 1) The Kicking Machine (a machine that kicks a ping pong ball); 2) The Convenient Carrier (a convenient way for some one using crutches or a wheelchair to carry small personal items); 3) The Rubber Band Car (using a rubber band as the power source, create a car with only two wheels–two CDs–that can go really far and fast); 4) The Rubber Band-Powered Rover (a vehicle with cardboard wheels that can scramble across the floor); and 5) Watercraft (a boat built with straws and plastic wrap) that can hold 25 pennies for at least ten seconds without sinking.

This activity was the highlight of the evening. The students participated enthusiastically until after 10:00 pm. The projects were judged and team winners selected by the faculty/staff participants who accompanied the students to the workshop. The students had an opportunity to meet students from other institutions, and no inter-institutional rivalries were developed since each team included representatives from all of the institutions. The students were strongly encouraged to serve as near peer mentors and share their experiences with younger students to help motivate them towards engineering careers.

SATURDAY, NOVEMBER 14, 2009

Opening Session: Mentoring Models for Success

Dr. McBay opened the session with a brief discussion in which participants shared highlights of the previous day's activities. She acknowledged the winners of the design competition and thanked the students for their enthusiastic participation and the faculty for serving as judges.

Keynote Speaker: Dr. Karl Reid, Senior Vice President,
Academic Programs and Strategic Initiatives, United Negro College Fund, Inc.

Dr. Reid's discussed "Why Mentoring Works" and offered a mentoring achievement model. He reflected on the many mentors in his life and the key benefits gained from each of the relationships he formed. His remarks then focused on his research on perceived self-efficacy (confidence in your academic ability and technical knowledge) as a result of effective mentoring. Dr. Reid told the group that performance outcomes for students included positive attitudes, greater effort, better time management, greater resilience, and lower stress and anxiety. He stressed that the factors important for college students include academic confidence, opportunities to engage encouraging faculty on a personal level, persistence, high expectations, and greater campus involvement. In a study on *Why mentoring matters*, African American males who were most successful did not allow their race to be a limiting factor; had greater campus involvement; a high level of academic self-efficacy; and more interactions with faculty.

Dr. Reid, former Associate Dean of Undergraduate Education and former Director of the Office of Minority Education at MIT, observed that some students suffer from the "wounded dog" syndrome: although they are having difficulty, they do not seek help. He described the MIT Freshman Efficacy Seminars in which students have roundtable discussions with faculty/staff to explore a range of topics through:

- A review of each participant's goals, academic assignments, commitments, and recent outcomes
- Discussion centered on the participant's challenges, concluding with a collaboratively-generated solution
- A discussion and activity based on readings or other assignments
- Participants' discussions of their commitments and goals for the following week

Dr. Reid also mentioned MIT's Laureates and Leaders Program that facilitates mentoring relationships for a cohort of students interested in attending graduate school. He shared the results of several mentoring studies/programs and noted that the frequency of student-mentor contact is positively correlated with program satisfaction.

Student Panel Views on Mentoring – Students' Perspectives

Ms. Ashley Allen, Junior, Chemical Engineering, Howard University; Ms. Nicole Febles, Senior, Biomedical Engineering, The City College of New York; and
Mr. Ruben Perez Rivera, Senior, Civil Engineering, University of Puerto Rico-Mayaguez

The three student participants gave their views on what works and on ways to improve the mentoring relationship. Ms. Allen remarked that her mentoring relationship had helped in the setting of goals. She also stated she has different mentors who assist her in addressing different issues (e.g., she views her father as a mentor; she also has an academic mentor). Ms. Allen distinguished her mentor from her academic advisor by observing that she sees her advisor only when she registers for courses. She noted an improvement in her work with the involvement of a faculty mentor. This relationship made it easier for her to make the transition into the discipline and helped to reinforce her confidence in her own abilities.

Mr. Rivera stated that "you can have the knowledge but not be educated" and the mentor can provide assistance to bridge the gaps in learning. He said that time was too valuable to waste and stressed the importance of a student showing the mentor that he/she is working hard, is tackling problems, is not afraid to talk with the mentor about problems, and is not wasting the mentor's time. Mr. Rivera noted that students should: have a diversity of mentors who are multi-disciplinary; be willing to take some risks (be persistent in seeking advice); and communicate regularly with mentors.

Ms. Febles discussed the differences in the environments she faced when she transferred from a community college in New Jersey to City College. She had no research exposure and was intimidated by the challenges she faced. However, she found that the faculty at City College with whom she interacted were caring and approachable and the graduate assistants were willing to assist her. She said that the mentoring relationships gave her a feeling of being "home away from home." Ms. Febles recommended that faculty mentors do the following for their students: consistently reinforce positive behavior; give honest and clear feedback; and provide access to the knowledge/tools they possess.

In response to questions and comments from the audience, the students said the following:

- Peer Mentors can provide advice based on their recent academic/life experiences
- Working with others in peer groups/teams is beneficial to growth and learning
- The mentor's race/ethnicity has no impact on the mentor's effectiveness; it's more important that the mentor demonstrates proper professional behavior; shares what he/she knows, and develops a shared connection with the mentee

Students in the audience also noted that the mentoring experience "helps you to deal with new experiences and tackle problems." They said it also "teaches you to multi-task, manage your time better, and balance academic and research responsibilities."

Faculty Panel Views on Mentoring – Mentors' Perspectives

Dr. Christine Ortiz, Associate Professor, Materials Science and Engineering, Massachusetts Institute of Technology; Dr. S. Keith Hargove, Dean of Engineering, Tennessee State University; and Dr. Delia Valles-Rosales, Associate Professor, Industrial Engineering, New Mexico State University

These three faculty advisors discussed their backgrounds and experiences as well as their views on what works in mentoring. They also provided recommendations on ways to improve the mentoring relationship in order to enhance student academic growth. They all reported having mentors who encouraged them at an early stage to pursue academic careers.

Dr. Ortiz stated that she appreciated the creative freedom and independence that comes with being a professor. She presented a variety of "reasons to pursue academia" by highlighting the opportunities she has had to work with science and engineering professionals in academe, government, and industry. She described the advantages ultimately gained from unforeseen benefits of working in academia, e.g., "you get to choose with whom you work, from students to collaborators," and exposure to amazing students. Dr. Ortiz stated that a faculty mentor can provide a student mentee with early exposure to research and also demonstrate passion for/love of science. She encouraged the students to: further develop their personal (e.g., initiative, interpersonal, and cultural fluency) as well as their scientific and technical skills; explore a range of career options; and focus on the long-term by visualizing themselves in a graduate environment.

Dr. Hargrove reiterated the plea for more Ph.D.s in engineering from underrepresented groups and strongly encouraged the students to pursue doctorates. He discussed how to manage mentoring relationships to facilitate advancement and recommended that each student assume the responsibility for building his/her "mentoring team" made up of peers, faculty, co-workers, and community members. He noted that identifying the right "coach" was important; formalizing the relationship reinforced responsibilities; and that the mentor does not have to "look like you." Dr. Hargrove described two types of mentors: *instrumental* (provides access to specific resources) and *developmental* (coaches/advises on how to navigate the specific environment). He also encouraged the students to conduct self-appraisals; identify potential mentors across various levels; be good apprentices; and be open to constructive criticism.

Dr. Valles-Rosales provided an overview of several STEM programs at New Mexico State and discussed what works in mentoring. She described the Enlace Program, a mentoring-based initiative that focuses on first semester students' career development, providing them help in setting priorities and establishing professional goals. Dr. Valles-Rosales described the benefits gained from working with peer mentors, completing internships, networking, and working with research groups on projects (e.g., enhanced leadership and communication skills). She encouraged the students to join a research group and to attend professional conferences.

Questions and comments that followed from the audience discussion identified several mentoring challenges and led to additional recommendations:

- Students should find out the track record of a potential mentor
- Students should not take criticism from their mentors personally as well as realize that every mentor is different and that no mentor is perfect.
- Although faculty members are busy, they should find time to mentor students, learn more about their students, and help students handle criticism

The faculty advisors cautioned the students not to depend on having only one mentor, and to seek information from as many mentors as possible, including graduate students and peers.

Concurrent Breakout Sessions – Part III

The General Topic for this breakout session was *Preparing Engineering Students to Meet Professional Expectations*.

- Sophomores discussed: "Using PowerPoint and Other Tools for Effective Presentations; Interacting Effectively with Your Advisor; Writing Personal Essays; and Mentoring Younger Students"
- Juniors discussed: "Test-Taking Strategies; Making Effective Presentations at Meetings/Conferences; Picking a Recommender; Update of Personal Profiles and Career Plans; and Peer Mentoring"
- Seniors discussed: "Test-taking Strategies; Writing a Research Plan; Making Effective Presentations at Meetings/Conferences; Developing a Career Portfolio; and Peer Mentoring"

Sophomores also discussed graduate school planning and advanced degree requirements. Juniors also discussed categories of the roles and responsibilities of engineering professionals (e.g., management, technical research, and service) and the related impact of advanced degrees on each category. Seniors also discussed the profile of a competitive graduate school candidate and how to maximize scholarly productivity, including hands-on research experiences.

A session for faculty also took place at the same time as the concurrent breakout sessions for students. The highlights of the session for faculty are provided below.

Faculty Development Session B

The faculty breakout session focused on:

- Developing and Evaluating Campus-based Mentoring Programs
- Establishing Student Chapters of Professional Organizations
- Providing Hands-on/ Practice Opportunities for Engineering Majors;
- Planning Campus-based Activities for Keeping Students on the Higher Education Path

Dr. David James, Consultant for DPJ Mentoring and President Emeritus of the International Mentoring Association, discussed "best practices" for developing and evaluating mentoring programs. He provided several definitions of mentoring that reflect "best practices," including the following:

- The process of one person sharing, giving a bit of the essence of himself/herself to another person so that person might grow closer to what he/she is capable of being
- The process of leading, guiding, keeping interest alive, supporting, counseling, teaching, coaching, demonstrating, and challenging, within a relationship of mutual trust and respect
- Taking another under one's wings and providing him/her a nurturing place to develop his/her own wings and a flight plan
- The process in which two or more individuals share a vision to achieve mutual growth and development

The faculty session also included a discussion on the importance of an institutional systemic mentoring program, with clear and well-communicated rules for the mentor/protégé relationship.

Dr. Garrick Louis discussed the benefits to students, faculty, and the institution of establishing student chapters of professional societies. He reviewed relevant ABET criteria and outlined necessary implementation steps. He also described activities and various opportunities for faculty to provide students with hands-on practice in engineering, including via class projects, student organizations, and research groups.

Closing Luncheon Session

Keynote Speaker: Dr. Eugene DeLoatch, Dean, School of Engineering
Morgan State University

Dr. DeLoatch began his remarks on "Engineering Achievements in Today's Society" by noting that, in 1952, there was no countable number of African Americans in engineering. Dr. DeLoatch pointed out the significance of being an engineer in the new global environment. In characterizing engineers and engineering, he stated that:

- Engineers have made a difference in the world; we like to call them scavengers. They create things that have never been.
- Engineers are paid fairly well in this society, and there continues to be a shortage of engineers in the U.S., which has a negative drag on the economy.
- Engineering is critical to societal advancement.

Dr. DeLoatch then focused his presentation on describing the greatest engineering achievements of the 20th Century and the grand challenges for engineering in the 21st Century. (see the respective lists below). He discussed the impact of these achievements on society as well as students' current role in meeting the challenges of the future for the betterment of society. Throughout his talk, Dean DeLoatch conveyed his excitement about the new learning environments in which the students would be involved; offered to exchange places with them; and wished them well in their pursuit of academic and professional success.

Greatest Engineering Achievements of the 20th Century

Electrification	Highways
Automobile	Spacecraft
Airplane	Internet
Water supply and distribution	Imaging
Electronics	Health technologies
Radio and television	Household appliances
Agricultural mechanization	Petroleum and petrochemical technologies
Computers	Laser and fiber optics
Telephone	Nuclear technologies
Air conditioning and refrigeration	High performance materials

Source: Greatest Engineering Achievements website http://www.greatachievements.org/ adapted from book, A Century of Innovation: Twenty Engineering Achievements That Transformed Our Lives developed through a project initiated by the National Academy of Engineering.

Grand Challenges for Engineering in the 21st Century

Make solar energy economical	Prevent nuclear terror
Provide energy from fusion	Secure cyberspace
Develop carbon sequestration methods	Enhance virtual reality
Manage the nitrogen cycle	Advance personalized learning
Provide access to clean water	Engineer the tools of scientific discovery
Advance health informatics	Restore and improve urban infrastructure
Engineer better medicines	Reverse-engineer the brain

Source: Grand Challenges website http://www.engineeringchallenges.org/ developed through a project initiated by the National Academy of Engineering

Finalizing Your Mentoring Agenda and Plans –Taking it Back to Campus

Nine student participants and two faculty advisors were identified as "reporters" during the eleven concurrent sessions and asked to provide summaries of the breakout group discussions at the closing session. They shared highlights of the sessions and discussed their plans for next steps once returning to campus.

The students indicated they would share their workshop materials and experiences with peers on campus, meet with their mentors to discuss their Individual Mentoring and Academic/ Career Plans (IMAPs), and gather more information on the research and graduate school opportunities discussed at the workshop. Faculty participants also planned to share the information and materials with students and other mentees as well as with colleagues and department leadership. The students were encouraged to further develop and maintain the peer network of contacts across the participating institutions as well as mentor/reach out to younger students.

EVALUATION

To obtain feedback regarding the workshop sessions, QEM distributed separate questionnaires to faculty and students that were completed at the end of the workshop. Below is a summary of the analysis of the results from the faculty and student questionnaires.

Responses from the Faculty

Thirteen (13) of 20 or 65 percent of the faculty participants completed a QEM workshop evaluation questionnaire. A total of 84.7 percent of the respondents rated the overall workshop as excellent or very good; 69.3 percent rated the clarity of the goals as excellent or very good; 84.6 percent rated the usefulness of assistance offered as excellent or very good; 84.6 percent rated the potential usefulness of materials provided as excellent or very good; and 61.6 percent of rated the length of the workshop as excellent or very good. Eleven (11) or 84.6 percent of the 13 faculty respondents indicated that the workshop met their expectations.

Based on an analysis of questionnaire results from individual workshop sessions, all (100 percent) of the faculty respondents rated the session on *Mentoring: Models for Success* and the session on *Engineering Achievements in Today's Society* as excellent or very good. In addition, 84.7 percent of the faculty respondents rated the session on *Faculty Development: Preparing Engineering Majors to Meet Professional Expectations* and the session on *Modeling and Fostering Professional Conduct: Professional Ethics and Decorum* as either excellent or very good.

A total of 69.3 percent of respondents rated each of the following sessions as excellent or very good: *Modeling and Fostering Professional Conduct: Scholarly Productivity: Conducting Research; Preparing Engineering Majors to Meet Academic Expectations: Skill Sets; and Views on Mentoring-Mentors' Perspectives.* Also, 77 percent of faculty respondents rated the session on *Views on Mentoring Students-Students' Perspectives* as excellent or very good.

Responses from Students

Sixty (60), or 42.3 percent, of the 142 student participants responded to the QEM Evaluation Questionnaire at the close of the Workshop. Fifty-five (55) or 91.7 percent of the 60 respondents answered "yes" to the question "Based on your experiences, did the workshop achieve the overarching goal"? Students also rated the sessions given below as being most helpful. The top five are listed in rank order from top to bottom.

Most Helpful Sessions As Rated by the Students

1. Concurrent Breakout Sessions
2. Applying to Graduate School and Financing a STEM Graduate Education
3. Engineering Design Competition
4. Preparing Students to Meet Tomorrow's Challenges in Engineering
5. Mentoring: Models for Success

Least Helpful Sessions As Rated by the Students

1. Entrepreneurship
2. Modeling and Fostering Professional Conduct
3. Student/Faculty Panels
4. Engineering Design Competition
5. What Research Tells Us about Successful Mentoring of Undergraduate Engineering Students

Recommendations

- Hold another engineering mentoring workshop next year; make adjustments using feedback from students and faculty participants at the first workshop. Plans for the workshop agenda should incorporate advice from undergraduate engineering students and from faculty who mentor these students. The next workshop should enhance the opportunities for student-student and faculty-faculty interactions regarding mentoring of undergraduates.

- Continue and strengthen small breakout group discussions on various topics related to mentoring. In the next workshop, allow students to choose sessions they believe are relevant to them as well as sessions that separate students by academic level (sophomores, juniors, and seniors).

- Allow more time for participating institutions to share "what works" regarding the mentoring of undergraduate underrepresented engineering majors.

- Increase focus on mentoring/supporting engineering students with special needs.

- Package the materials used in the Engineering Design Competition prior to the workshop to facilitate the flow of and minimize the time students spend on this activity.

NEXT STEPS

Individual Mentoring and Academic/Career Plans (IMAPs) completed by the students during the workshop were submitted to QEM. They are being reviewed by QEM staff who will then follow-up with students on their progress in meeting their outlined goals and objectives. A copy of the IMAP template is provided at **Appendix C**. The workshop participants are expected to share the experiences and information they received with their campus colleagues.

To facilitate sharing, presentations were linked to the workshop agenda at QEM's website: (http://qemnetwork.qem.org/QEM_ENGMentoringWkshpAgendaFinal.htm). Students and their advisors were encouraged to take the time to review the workshop information packet and CD of resources and also to share the presentations with other students and faculty in their respective departments.

The IMAPs completed by the students during the workshop and submitted to QEM were duplicated and returned to the students by mail in sealed envelopes. Students were asked to share the IMAPs with the mentors they identified on the forms and to continue to update their IMAPs. QEM will follow-up with the students in February 2010 and June 2010 to get formal updates on their progress in achieving the goals outlined in their IMAPs.

In response to participant feedback about the need for the increased involvement of senior faculty on campus in the retention and mentoring of engineering students, QEM will explore the possibility of a follow-up workshop focused on senior engineering faculty and senior engineering administrators.

The workshop provided an opportunity for students to meet and interact with peers from across the country with similar interests and aspirations. They also met outstanding mentors in a range of careers with whom they discussed pathways to academic and professional success. Students were encouraged to further develop and maintain the peer network of contacts across the participating institutions as well as mentor/reach out to younger students. The workshop made clear that effective mentoring can lead to a significant increase in the number of minority students who obtain baccalaureate and doctoral degrees in engineering, thereby strengthening the nation's global competitiveness in science and technology.

APPENDICES

Appendix A: Detailed Workshop Agenda

Appendix B: Brief Biosketches of Presenters

Appendix C: Individual Mentoring and Academic/Career Plan (IMAP) Template

APPENDIX A

QUALITY EDUCATION FOR MINORITIES (QEM) NETWORK
MENTORING WORKSHOP FOR UNDERREPRESENTED MINORITY UNDERGRADUATE ENGINEERING STUDENTS AND FACULTY/STAFF ADVISORS
The Four Points by Sheraton BWI Airport • Baltimore, MD
NOVEMBER 13-14, 2009

DETAILED AGENDA

Purpose: This workshop will focus on the mentoring and professional development of underrepresented minority undergraduate Engineering students.

THURSDAY, NOVEMBER 12

PM

7:00 ***Early Registration and Reception*** *Crane Ballroom*

FRIDAY, NOVEMBER 13

AM

8:00 *Registration and Continental Breakfast* *Crane Foyer*

8:30 Opening Plenary: *Crane Ballroom*
Welcome, Purpose, and Introductions
Shirley McBay, President, QEM Network
Omnia El-Hakim, Program Director of Diversity and Outreach
Directorate for Engineering (ENG), National Science Foundation (NSF)

8:45 *Effective Mentoring Strategies for Enhancing the Success of Underrepresented Minorities in Engineering*
Introduction of Speaker: Costello Brown, Senior Associate, QEM Network

Keynote Speaker: Percy Pierre, Professor of Electrical and Computer Engineering
College of Engineering
Michigan State University
2008 AAAS Lifetime Mentor Award Recipient and NACME Founder

9:15 Plenary Session: *What Research Tells Us about Successful Mentoring of Undergraduate Engineering Students*
Panelists:
Lorelle Espinosa, Director, Policy and Strategic Initiatives
Institute for Higher Education Policy (IHEP)
Susan Staffin Metz, Senior Advisor
Center for Innovation in Engineering and Science Education
Stevens Institute of Technology

Moderator: Shirley McBay, QEM Network

9:45 *Questions and Comments from Audience*

10:00 Plenary Session: *Career Pathways in Engineering: Exploring Options in Academe and Industry*

Brief Review of Workforce STEM Trends

Panelists:
Garrick Louis, Associate Professor
Department of Systems and Information Engineering, University of Virginia, and QEM Consultant
Stephanie Adams, Associate Dean for Undergraduate Studies and Associate Professor, Department of Mechanical Engineering School of Engineering, Virginia Commonwealth University, and QEM Consultant

Moderator: Laura-Lee Davidson, Associate, QEM Network

10:30 *Questions and Comments from Audience*

10:45 *Coffee Break*

11:00 *Concurrent Breakout Sessions (co-led by QEM Consultants and Senior Staff) (students grouped by Academic Level – sophomore; junior; senior)*

Topic: *Preparing Undergraduate Engineering Majors to Meet Academic Expectations: Developing Individual Mentoring and Academic/Career Plans (IMAPs)*

Group I: Sophomores *Scott Room*
- *Academic Requirements and Course Timetables*
- *Building Effective Study Habits*

Discussion Leaders: Garrick Louis, QEM Consultant
Costello Brown, Senior Associate, QEM Network

Group II: Juniors *Carlton Room*
- *Graduate School Planning: Test Preparation*
- *Personal Profile Development*

Discussion Leaders: Stephanie Adams, QEM Consultant
J. Arthur Jones, Senior Associate, QEM Network

Group III: Seniors *Chesapeake Ballroom*
- *Mentoring Younger Students*
- *Graduate School Planning*
- *Portfolio and Personal Profile Development*

Discussion Leaders: Brian Blake, Professor and Associate Dean for Strategic Initiatives, College of Engineering University of Notre Dame, and QEM Consultant
Laura-Lee Davidson, QEM Network

Noon

12:00 *Luncheon – Preparing Students to Meet Tomorrow's Challenges in Engineering* *Crane Ballroom*

Introduction of Speaker: J. Arthur Jones, QEM Network

Guest Speaker: Victor McCrary, Business Area Executive, Science and Technology The Johns Hopkins University Applied Physics Laboratory

PM

1:30 Plenary Session**:** *Modeling and Fostering Professional Conduct* *Crane Ballroom*

Moderator: J. Arthur Jones, Senior Associate, QEM Network

– *Professional Ethics and Decorum*
- *Ethical Conduct and Standards*
- *Professional Workplace Behavior: Basics all Students Should Know*
- *Role of Student Chapters of Professional Organizations*

Rose Wesson, Program Director, Division of Chemical, Bioengineering, Environmental, and Transport Systems (CBET), Directorate for Engineering, NSF

– *Scholarly Productivity: Conducting Research*
- *Identifying STEM-focused Research Opportunities*
- *Conducting Literature Searches*
- *Reading and Preparing Scholarly Articles*
- *Professional Team-Building Exercises*

Brian Blake, University of Notre Dame and QEM Consultant

2:15 *Questions and Comments from Audience*

2:30 Plenary Session**:** *Applying to Graduate School; Financing a STEM Graduate Education*

– *Test Preparation (GRE), Portfolios, and the Personal Essay*
– *Fellowships and Scholarships*
- *NSF Graduate Research Fellowship (GRF) Program*
- *NACME* and *GEM Fellowships*
- *LSAMP Bridge to the Doctorate*

Panelists:
Carmen Sidbury, Program Director, Division of Graduate Education (DGE)
Directorate for Education and Human Resources (EHR), NSF
A. James Hicks, Program Director, Alliances for Broadening Participation in STEM
Division of Human Resource Development, EHR, NSF
Michele Lezama, Executive Director, The National Consortium for
Graduate Degrees for Minorities in Engineering and Science, Inc. (GEM)

Moderator: Costello Brown, QEM Network

3:15 *Questions and Comments from Audience*

3:30 *Coffee Break*

3:45 Plenary Session: *Entrepreneurship*

Juan Figueroa, Program Director, Small Business Innovation Research (SBIR)
Cheryl Albus, Program Director, SBIR
Division of Industrial Innovation and Partnerships (IIP)
Directorate for Engineering, NSF

4:15 *Concurrent Breakout Sessions*

Topic: *Preparing Engineering Majors to Meet Academic Expectations: Skill Sets*

Group I: Sophomores *Scott Room*
- *Resume Development for Internships and Co-op Opportunities*
- *Update of Individual Mentoring Plan*
- *Team-building Strategies*

Discussion Leaders: Garrick Louis, QEM Consultant
Costello Brown, QEM Network

Group II: Juniors — *Carlton Room*

- *Resume Development for External Research/Practice Opportunities*
- *Research Experiences for Undergraduates (REU)*
- *Update of Personal Profiles and Individual Mentoring Plans*

Discussion Leaders: Stephanie Adams, QEM Consultant
J. Arthur Jones, QEM Network

Group III: Seniors — *Chesapeake Ballroom*

- *Portfolio and Personal Profile Development*
- *Global Research Opportunities*
- *International Research Experiences for Students (IRES)*
- *Writing a Research Abstract*

Discussion Leaders: Brian Blake, QEM Consultant
Laura-Lee Davidson, QEM Network

Group IV: Faculty Development Session — *Crane C*

- *Preparing Undergraduate Students to Meet Academic Expectations*
- *Mentoring/Supporting Engineering Students with Special Needs*
- *Best Practices in Advising and Mentoring Engineering Students*

Discussion Leader: Alvin P. Kennedy, Chair, Department of Chemistry
Morgan State University

5:30 *Break*

6:00 *Dinner* — *Crane Ballroom*

"Broadening Participation Opportunities in Engineering at the National Science Foundation"

Remarks: Omnia El-Hakim, Directorate for Engineering, NSF

7:00 Hands-on Project Team Meetings – Design and Development — *Crane Ballroom*

(Students are grouped in cross-institutional teams to develop/assemble projects for competition; faculty/staff observe and provide support)

8:00 ***Engineering Design Competition***

(Teams test ideas)

SATURDAY, NOVEMBER 14

AM

8:00 *Continental Breakfast* — *Crane Foyer*

8:30 Plenary Session: *Review of Day One and Overview of Day Two* — *Crane Ballroom*
Shirley McBay, President, QEM Network

8:45 *Mentoring: Models for Success*
Introduction of Speaker: Althea Burns, Associate, QEM Network
Guest Speaker: Karl W. Reid, Senior Vice President
Academic Programs and Strategic Initiatives
United Negro College Fund, Inc.

9:15 Student Panel: *Views on Mentoring – Students' Perspectives*
(Students discuss their views on What Works and on Ways to Improve the Mentoring Relationship)

Panelists:
Ashley Allen, Junior, Chemical Engineering, Howard University
Nicole Febles, Senior, Biomedical Engineering
The City College of New York (CCNY)
Rubén Pérez Rivera, Senior, Civil Engineering
University of Puerto Rico (UPR)–Mayaguez
Moderator: Laura-Lee Davidson, QEM Network

9:45 Faculty Panel: *Views on Mentoring – Mentors' Perspectives*
(Faculty discuss views and experiences on What Works and on Ways to Improve the Mentoring Relationship)

Panelists:
Christine Ortiz, Associate Professor, Materials Science and Engineering
Massachusetts Institute of Technology
S. Keith Hargrove, Dean of Engineering, Tennessee State University
Delia J. Valles-Rosales, Associate Professor, Industrial Engineering
New Mexico State University
Moderator: Laura-Lee Davidson, QEM Network

Questions and Comments from Audience

10:30 *Coffee Break*

10:45 *Concurrent Breakout Sessions*

Topic: *Preparing Engineering Majors to Meet Professional Expectations*

Group I: Sophomores — *Scott Room*
- *Use of PowerPoint and Other Tools for Effective Presentations*
- *Interacting Effectively with your Advisor*
- *Writing Personal Essays*
- *Mentoring Younger Students*

Discussion Leader: Costello Brown, QEM Network

Group II: Juniors *Carlton Room*

- *Test-taking Strategies*
- *Making Effective Presentations at Meetings/Conferences*
- *Picking a Recommender*
- *Update of Personal Profiles and Career Plans*
- *Peer Mentoring*

Discussion Leaders: Stephanie Adams, Virginia Commonwealth University
J. Arthur Jones, QEM Network

Group III: Seniors *Chesapeake Ballroom*

- *Test-taking Strategies*
- *Writing a Research Plan*
- *Making Effective Presentations at Meetings/Conferences*
- *Developing a Career Portfolio*
- *Peer Mentoring*

Discussion Leaders: Brian Blake, University of Notre Dame
Laura-Lee Davidson, QEM Network

Group IV: Faculty Development Session *Crane C*

- *Developing and Evaluating Campus-based Mentoring Programs*
- *Establishing Student Chapters of Professional Organizations*
- *Providing Hands-on/Practice Opportunities for Engineering Majors*
- *Planning Campus-based Activities for Keeping Students on the Higher Education Path*

Discussion Leaders: Garrick Louis, University of Virginia
David James, Consultant, DPJ Mentoring and
President Emeritus, International Mentoring Association

Noon/PM

12:00 *Luncheon – Engineering Achievements in Today's Society* *Crane Ballroom*

Introduction of Speaker: J. Arthur Jones, QEM Network

Guest Speaker: Eugene DeLoatch, Dean, School of Engineering
Morgan State University

1:30 Closing Plenary (Next Steps): *Crane Ballroom*

Finalizing Your Mentoring Agenda and Plans –Taking it Back to Campus

Facilitator: Althea Burns, QEM Network

Faculty Present Campus-based Activity Plans (Summaries from Breakout Sessions)
Students Share Highlights of Next Steps to be Taken (Summaries from Breakout Sessions)

Concurrent Sessions (Friday AM)
Preparing Undergraduate Engineering Majors to Meet Academic Expectations: Developing Individual Mentoring and Academic/Career Plans (IMAPs)

Concurrent Breakout Sessions (Friday PM)
Preparing Engineering Majors to Meet Academic Expectations: Skill Sets

Concurrent Breakout Sessions (Saturday AM)
Preparing Engineering Majors to Meet Professional Expectations

3:00 *Reflections and Closing Comments*

3:30 *Adjournment*

APPENDIX B

BRIEF BIOSKETCHES OF WORKSHOP PRESENTERS

ADAMS, Stephanie
Stephanie Adams is Associate Dean for Undergraduate Studies and Associate Professor, Mechanical Engineering, in the School of Engineering at Virginia Commonwealth University. In 2003, she received a prestigious CAREER Award from the National Science Foundation to support her goal of designing, developing, and validating a model for the facilitation of effective teaming in the engineering classroom and for the enhancement of learning. During 2006-2007, she served at NSF as an American Association for the Advancement of Science (AAAS)/NSF Science and Engineering Fellow in the Engineering Directorate's Division of Engineering Education and Centers.

BLAKE, Brian
Brian Blake is Professor and Associate Dean for Strategic Initiatives, College of Engineering, at the University of Notre Dame. His research interests lie in the investigation of automated approaches to sharing information and software capabilities across organizational boundaries, sometimes referred to as *enterprise integration.* Dr. Blake has received several grants from the National Science Foundation and the National Institutes of Health in support of his research and education efforts and has published broadly in a number of professional journals.

DELOATCH, Eugene
Eugene DeLoatch is Dean, School of Engineering, at Morgan State University. Prior to assuming this position in July 1984, he served as Professor and Chairman of the Department of Electrical Engineering (1975-1984) at Howard University. In recognition of his commitment to attaining and promoting excellence in engineering through research and education, Lafayette College awarded him an Honorary Doctor of Engineering degree in 1998. Dr. DeLoatch served as President of the American Society for Engineering Education (ASEE) in 2002-2003. Dr. DeLoatch formerly served on the National Research Council's Board of Engineering Education and is a co-founder of the Annual Black Engineer of the Year Program.

ESPINOSA, Lorelle
Lorelle Espinosa is Director for Policy and Strategic Initiatives at the Institute for Higher Education Policy (IHEP). She provides leadership in aligning IHEP research, programs, policy initiatives, and other services with the Institute's strategic direction. Dr. Espinosa serves as the Institute's expert on current and anticipated education policy issues—which in part informs IHEP's research and programmatic agendas—and is responsible for informing and implementing IHEP's strategic agenda. Dr. Espinosa's responsibilities include establishing and managing collaborative external partnerships and initiatives to meet key organizational objectives for advancing college access and success for all students, with particular attention to underrepresented groups at the pre-college and college levels.

HARGROVE, Keith
Keith Hargrove is Dean and Professor of Engineering at Tennessee State University. Prior to this position, Dr. Hargrove served as Chair, Department of Industrial Engineering, at Morgan State University. His teaching and research interests include manufacturing systems design and optimization; statistical applications in manufacturing; environmental manufacturing management; and minorities in engineering education. Dr. Hargrove is the recipient of several honors and awards. These include the GEM Alumni Award for Mentoring; Who's Who Among America's Teachers; Faculty of the Year Award from Tuskegee University; and the Outstanding Educator Award from the Freemasons Prince Hall Regional Chapter.

JAMES, David
David James is Consultant, DPJ Mentoring, and President Emeritus, International Mentoring Association. He has expertise in training mentors and in establishing and evaluating mentoring programs. Dr. James has made numerous presentations on mentor and protégé training and on the essential elements for comprehensive formalized mentoring programs. His experience includes conducting "Best Practices"

workshops that linked community, corporate, and educational programs;. Previously, he served as Dean of Educational Development and Degree/Extension Centers and Special Programs at Prince George's County Community College. He has written extensively on the subject of mentoring and retention in such publications as the *International Journal of Mentoring* and *New Directions for Community Colleges*.

KENNEDY, Alvin
Alvin Kennedy is Chair and Professor of Chemistry at Morgan State University. He is an active researcher in the development of impedance spectroscopy that is used to monitor chemical and polymer reactions. Dr. Kennedy has received grants from NASA in support of his research, including a NASA Faculty Award for Research (FAR) and a NASA Minority-serving Universities Infrastructure Grant. He also served as principal investigator of a National Science Foundation (NSF) HBCU Capacity Building Grant to develop a center for biological and chemical sensors research at Morgan State. Dr. Kennedy also was selected to serve as a NASA/ASEE Fellow at the Center for Microgravity Materials Research at the Marshall Space Flight Center. He has published widely on his research and holds several patents as well.

LEZAMA, Michele
Michele Lezama is Executive Director of the National Consortium for Graduate Degrees for Minorities in Engineering and Science, Inc. (GEM). GEM was founded at the University of Notre Dame and is dedicated to increasing the number of under-represented minority students who pursue and receive a master's or Ph.D. degree in engineering or science by providing full fellowships and conducting informational programs on the application and graduate school experience. Ms. Lezama began her post as Executive Director of GEM after serving as Executive Director of the National Society of Black Engineers (NSBE). She is credited with significantly increasing NSBE's operational efficiency, programmatic efforts, and financial reserves. Under Ms. Lezama's leadership, NSBE received the 2003 Presidential Award for Excellence in Science, Mathematics and Engineering Mentoring.

LOUIS, Garrick
Garrick Louis is Associate Professor of Systems & Information Engineering and Associate Professor of Environmental Engineering at the University of Virginia (UVA). Before coming to UVA, he was a Green Design Post-doctoral Fellow at Carnegie Mellon University, a Warren Weaver Fellow in the Global Environment Division of the Rockefeller Foundation, and a faculty member at the State University of New York. Dr. Louis founded and directs the Design-in-Action Network that provides technical assistance to sanitation projects in rural communities. He also is the faculty sponsor for the UVA chapter of "Engineering Students Without Borders." In 2000, Dr. Louis received a prestigious NSF CAREER Award and a Presidential Early Career Award for Scientists and Engineers (PECASE) in national recognition of his development of a research and educational program in sanitation systems.

MCCRARY, Victor
Victor McCrary is Business Area Executive for Science and Technology at The Johns Hopkins University Applied Physics Laboratory. He also currently serves as President of the National Organization for the Professional Development of Black Chemists and Chemical Engineers (NOBCChE). His prior work includes Division Chief at the National Institute of Standards and Technology and serving as a member of the technical staff at Bell Laboratories. In 1997, Dr. McCrary and a group of colleagues developed and introduced e-books to the science industry. In 2000, the U.S. Department of Commerce awarded him the Gold Medal for his work. Dr. McCrary seeks to bring more diversity to the field of science through his position as President of NOBCChE, an organization of more than 4,000 members.

METZ, Susan Staffin
Susan Staffin Metz is Senior Advisor, Center for Innovation in Engineering and Science Education, at Stevens Institute of Technology and founding Executive Director of the Institute's Lore-El Center for Women in Engineering and Science. As a founder and President (1997–2002) of Women in Engineering Proactive Network (WEPAN), Ms. Metz has worked with more than 200 colleges and universities to increase access and engagement of women in engineering and science through research, policy, and program development. Her work at Stevens Institute was recognized with the 1998 Presidential Award for

Excellence in Science, Mathematics, and Engineering Mentoring (PAESMEM). Ms. Metz has participated on a number of advisory boards including for the: National Academy of Engineering, National Science Foundation Engineering Directorate, and the American Association for the Advancement of Science's (AAAS') Center for Advancing Engineering and Science Capacity, and *MentorNet*.

ORTIZ, Christine
Christine Ortiz is Associate Professor, Materials Science and Engineering at the Massachusetts Institute of Technology. The focus of her research is on structural or *load-bearing* biological materials, in particular *musculoskeletal* (internal to the body) and *exoskeletal* (external to the body) tissues. The result and ultimate objective of her research is a fundamental, mechanistic-based understanding of tissue function, quality, and pathology. The scientific foundation being formed has relevance to both the medical and engineering fields. In July 2002, Dr. Ortiz received the Presidential Early Career Award for Scientists and Engineers (PECASE) for her creative research and for innovative outreach to high school teachers.

PIERRE, Percy
Percy Pierre is Professor, Department of Electrical and Computer Engineering, at Michigan State University. He also directs programs to recruit, retain, and graduate students in the College of Engineering, with an emphasis on underrepresented groups. His specific research interests are in the area of applications of stochastic models in engineering systems. Dr. Pierre is recognized as the first African American to earn a doctorate in electrical engineering and, during his career, has served in a series of administrative posts in government and higher education. He assisted in organizing and obtaining initial funding for several minority engineering organizations, including the National Action Council for Minorities in Engineering (NACME) and the National Consortium for Graduate Degrees for Minorities in Engineering and Science (GEM). His awards and honors include the American Association for the Advancement of Science (AAAS) Mentor Award for Lifetime Achievement; and the NACME Founder's Award.

REID, Karl
Karl Reid is Senior Vice President, Academic Programs and Strategic Initiatives, at the United Negro College Fund (UNCF), Inc. Prior to assuming this position, Dr. Reid served at the Massachusetts Institute of Technology (MIT) as Associate Dean of Undergraduate Education, Assistant to the Chancellor for Diversity, and Director of the Office of Minority Education. At UNCF, he is responsible for implementing strategies to develop and fund educational, research, and capacity-building programs at UNCF's member institutions. Additionally, he leads initiatives that support the scholarship and internship programs for the 8,000 students who have received UNCF scholarships to 900 colleges and universities around the country. During his tenure at MIT, he founded the Saturday Engineering Enrichment and Discovery (SEED) Academy and established the Science. Technology, Engineering, and Mathematics (STEM) Program, two year-round academic and mentoring programs for local high school and middle school students.

VALLES-ROSALES, Delia
Delia Valles-Rosales is Associate Professor, Department of Industrial Engineering, in the College of Engineering at New Mexico State University (NMSU). At NMSU, she has developed research projects that involve the optimization of manufacturing processes to protect the environment. Dr. Valles-Rosales' current research projects include industrial engineering of green manufacturing technologies; mathematical and simulation modeling in industrial engineering; and development of industrial models in agronomy production in New Mexico. She also has facilitated collaborations between and among companies and universities; worked to increase the pool of women and minorities in engineering careers; and served as Co-Director of the New Mexico Alliance for Minority Participation (NMAMP). She has received support for her research from the National Science Foundation's ADVANCE, LSAMP, and Bridge to the Doctorate Programs.

APPENDIX C: INDIVIDUAL MENTORING AND ACADEMIC/CAREER PLAN (IMAP)

The purpose of the Individual Mentoring and Academic/Career Plan (IMAP) is to provide you with a framework to assist with planning academic/career- and mentoring-related activities. The IMAP will: serve as a useful guide in establishing personal and professional skills development/learning objectives in order to meet your academic/career goals; and facilitate discussions with your mentor. Over time, you may need to periodically revise and/or make additions to your IMAP.

GOALS: Briefly describe below three goals (Academic / Professional / Mentoring) you wish to achieve that will enable you to increase your knowledge and level of preparation as a future Engineering professional.

OBJECTIVES: For each goal, describe at least one ***measurable*** objective you wish to achieve to accomplish that goal.

ACTIVITIES: Briefly describe the activities in which you propose to engage to accomplish each of these objectives.

SKILLS/RESOURCES NEEDED: Briefly describe the skills you will use/develop and the resources you will need to carry out these activities.

TIMELINE: Provide the proposed timeline for starting and completing each activity, assuming the resources needed are available.

NAME: _____ **INSTITUTION:** _____ **LEVEL:** _____

TEL: _____ **E-MAIL:** _____ **DATE:** _____

GOALS / OBJECTIVES *What do I want to achieve?*
ACADEMIC GOAL: **Objective 1:** **Objective 2:**
PROFESSIONAL GOAL: **Objective 3:** **Objective 4:**
MENTORING GOAL: **Objective 5:** **Objective 6:**

INDIVIDUAL MENTORING AND ACADEMIC/CAREER PLAN (IMAP), page 2

NAME: _____ **INSTITUTION:** _____ **DATE:** _____

GOALS *What do I want to achieve?*	**OBJECTIVE(S)** *What do I want to accomplish? (specific/attainable/measurable)*	**ACTIVITIES** *Methodology – What specific tasks will I undertake? How will I accomplish each objective?*	**SKILLS TO USE / DEVELOP and RESOURCES NEEDED**	**TIMELINE** *When will I do the activities outlined in column 3?*
ACADEMIC GOAL	Objective 1. Objective 2.	1.1 1.2 2.1 2.2		**START / COMPLETION**
PROFESSIONAL GOAL	Objective 3. Objective 4.	3.1 3.2 4.1 4.2		
MENTORING GOAL	Objective 5. Objective 6.	5.1 5.2 6.1 6.2		

With whom will you discuss this plan? Please give the name and position of the person and his/her institution/organization/affiliation.

NAME OF MENTOR: _____ **TITLE /POSITION:** _____

INSTITUTION / ORGANIZATION / AFFILIATION: _____

NATIONAL SCIENCE FOUNDATION (NSF) ENGINEERING DIRECTORATE
SELECTED OPPORTUNITIES FOR STUDENT SUPPORT

(excerpts from website, http://www.nsf.gov/dir/index.jsp?org=ENG)

Graduate Research Fellowship Program (GRFP) (through the Division of Graduate Education, EHR/NSF) (NSF 09-603) *http://www.nsf.gov/publications/pub_summ.jsp?WT.z_pims_id=6201&ods_key=nsf09603*

The Graduate Research Fellowship provides three years of support for graduate study leading to research-based master's or doctoral degrees and is intended for students who are in the early stages of their graduate study. The Graduate Research Fellowship Program (GRFP) invests in graduate education for a cadre of diverse individuals who demonstrate their potential to successfully complete graduate degree programs in disciplines relevant to the mission of the National Science Foundation.

Nanotechnology Undergraduate Education (NUE) in Engineering

(NSF 10-536) *http://www.nsf.gov/publications/pub_summ.jsp?WT.z_pims_id=13656&ods_key=nsf10536*

The Nanotechnology Undergraduate Education (NUE) in Engineering program aims to integrate nanoscale science, engineering, and technology into the undergraduate engineering curricula. The NUE program provides funding for projects that will address the educational challenges of these emerging fields and generate practical ways of introducing nanotechnology into undergraduate engineering education with a focus on devices and systems and/or on social, economic, and ethical issues relevant to nanotechnology. Given the worldwide expansion of research and education in nanoscale science and engineering, international collaborations that advance underlying nanoscale science and engineering education goals and strengthen U.S. activities are encouraged.

NSF/FDA SCHOLAR-IN-RESIDENCE AT FDA

(NSF 10-533) *http://www.nsf.gov/publications/pub_summ.jsp?WT.z_pims_id=5605&ods_key=nsf10533*

The National Science Foundation (NSF), through the Directorate for Engineering's Division of Chemical, Bioengineering, Environmental, and Transport Systems (CBET), and the U.S. Food and Drug Administration (FDA), through its Center for Devices and Radiological Health (CDRH) have established the NSF/FDA Scholar-in-Residence Program at FDA. This program comprises an interagency partnership for the investigation of scientific and engineering issues concerning emerging trends in medical device technology. This partnership is designed to enable investigators in science, engineering, and mathematics to develop research collaborations within the intramural research environment at the FDA. This solicitation features four flexible mechanisms for support of research at the FDA: 1) Faculty at FDA; 2) Graduate Student Fellowships; 3) Postdoctoral Fellowships; and, 4) Undergraduate Student Research Experiences. This activity supports research and collaborations with investigators in the intramural FDA laboratory research program including opportunities for faculty, postdoctoral fellows, and students to conduct engineering and scientific research on topics contributing to public health and to gain experience related to emerging medical device technologies in a research setting, both individually and in collaborative teams.

Cyberinfrastructure Training, Education, Advancement, and Mentoring for Our 21st Century Workforce (CI-TEAM)

(NSF 10-532) *http://www.nsf.gov/publications/pub_summ.jsp?WT.z_pims_id=12782&ods_key=nsf10532*

The CI-TEAM program supports projects that position the science and engineering community to engage in integrated research and education activities promoting, leveraging and utilizing cyberinfrastructure systems, tools and services. CI-TEAM awards will:

- Prepare current and future generations of scientists, engineers, and educators to design and develop as well as adopt and deploy, cyber-based tools and environments for research and learning, both formal and informal.
- Expand and enhance participation in cyberinfrastructure science and engineering activities of diverse groups of people and organizations, with particular emphasis on the inclusion of traditionally underrepresented individuals, institutions especially Historically Black Colleges and Universities (HBCUs) and Minority Serving Institutions (MSIs), and communities as both creators and users of cyberinfrastructure.

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