SCIENCE & ENGINEERING ALLIANCE

*"A Unique Resource for the Nation"*

# Building Science and Engineering Talent

# SEA Qualification Statement

## Background and Need

Science, mathematics, and engineering education in many countries is essential to achieving economic and societal goals both now and throughout the 21st century. Realization of this fact and the importance of the connection of education and knowledge to economic growth are essential. Evidence already exists that the lack of United States citizens in the science and engineering workforce is limiting economic growth, and business has looked to the H-1B Visas Program [foreign national workers filling jobs unfilled by American citizens] as a way to fill this gap **(1)**.

**Trends**

It is vitally important that more U.S. citizens gain a better understanding and appreciation of the impact science and technology has on quality of life. According to a published report **(2)**, enrollment in undergraduate programs by underrepresented minorities has increased in the past decades, and accelerated in the 1990s. African-American enrollment increased 3.6 percent annually in the 1990s, reaching 1.3 million in 1995. Hispanic enrollment in higher education increased at an even faster rate during this period, i.e., 7.1 percent annually.

According to reports published by the National Science Foundation (NSF) **(3,4)**, among freshman students from underrepresented minority groups planning to major in science or engineering, over 38 percent reported that they would need remedial work in math. In 1995, only 6 percent of the college-age population had completed a bachelor's degree in a natural science and engineering field, with 2 percent of African-American and Hispanic youth earning a bachelor's degree in a natural science and engineering field. Asian-Americans represents 4 percent of the U.S. population and has considerably higher than average participation rates, with over 12 percent earning a natural science and engineering degree. Low participation rates for African-Americans and Hispanics changed little throughout the 1980s, although they improved somewhat in the 1990s.

Enrollment in U.S. graduate science and engineering programs grew for approximately 20 years, reached a peak of 440,000 students in 1993, and then began to decline. The decline in enrollment has averaged 1 percent annually. Fewer students enrolling in engineering, mathematics, and the computer sciences account for most of this decline. Progress for underrepresented minorities in science and engineering graduate enrollment has been very modest. In 1975, they accounted for 3.7 percent of science and engineering graduate enrollment. By 1995, they accounted for 5.0 percent annually. The number of doctoral degrees in engineering, mathematics, and the computer sciences nearly doubled from 1985 to 1995. Women accounted for an increasing proportion of science and engineering doctoral degrees, while underrepresented minorities showed only a slight increase. By 1995, females earned almost half of the doctoral degrees in the social sciences, 38 percent in the biological sciences, and almost 12 percent in engineering. Underrepresented minorities received less than 5 percent of all science and engineering doctorates awarded in 1995, up slightly from 3 percent in 1977.

Foreign student enrollment grew until 1992 when it became stagnant. Despite the stagnation after 1992, long-term trends indicate that there is a rise in the number of foreign students enrolling in graduate science and engineering fields in the U.S. In fact, foreign born/non-U.S. citizens pursuing graduate training in science and engineering began to increase considerably again in 1999 with the percentage of graduate enrollment in the U.S. reaching an all-time high.

The total percentage of foreign graduate students enrolled in the U.S. was 26.7 percent versus 73.7 percent of U.S. citizens and permanent residents. In the social and behavioral sciences, foreign students represented 13.1 percent of the graduate population. The percentage of foreign enrollment was slightly more in the natural sciences (physics, chemistry, astronomy, earth and atmospheric, ocean, biological, and cultural sciences) altogether accounting for 24.0 percent of the U.S. graduate enrollment in these fields. However, foreign students were most prominent in graduate enrollment in the areas of mathematics/computer science and engineering, accounting for 39.2 percent in mathematics/computer science versus 60.8 percent of enrollment by U.S. citizens and permanent residents. Foreign students accounted for a little less than half of U.S. graduate school enrollment in the engineering field at 40.8 percent.

**Projections**

In 1995, the projected percentage of White men in the overall workforce was 36 percent. By 2050 White males are projected to be 26 percent of the overall workforce, while in 1997 they represented nearly 70 percent of the science and engineering workforce **(5)**. During 1998 - 2008 period, employment in science and engineering occupations is expected to increase at almost four times the rate for all occupations **(2,3).**

## SEA Program: Facilitating and Coordinating Production of Scientists and Engineers among an Underrepresented Segment of the U.S. Population

The Science and Engineering Alliance, Inc. (SEA) is a nonprofit consortium of four Historically Black Colleges and Universities (HBCUs) and a national laboratory. The four HBCUs are: Alabama A&M University (Huntsville, AL); Jackson State University (Jackson, MS); Prairie View A&M University (Prairie View, TX); and Southern University and A&M College (Baton

Rouge, LA). The national laboratory is Lawrence Livermore National Laboratory (Livermore, CA).

The SEA was formed in 1990 to develop programs for enhancing knowledge in the physical sciences and engineering, and to enhance and promote the educational institutions' combined capabilities, with the knowledge that by working together, the SEA will accelerate the production of scientists and engineers among people of color. Using this approach, the SEA is a unique resource that is contributing in a significant way to major national research efforts. Through the SEA, these four schools, with strong technical educational programs, are able to respond collectively to the national technical manpower needs.

The four SEA institutions have a combined student population of approximately 33,000 students, and a combined science and engineering faculty of approximately 400 Ph.D.s and 250 Master's degrees. By combining their fields of expertise and resources, these four Universities are able to contribute significantly to training and research to where the whole becomes greater than the sum of its parts [http://www.llnl.gov/sea/research.html].

The SEA mission is four-fold:

1. Initiate new, cutting-edge research projects that will foster collaboration among the member institutions, and strengthen faculty and student development;

2. Create partnerships that build on the member institutions' existing technical capabilities, as a basis for improving the research infrastructure;

3. Establish new faculty and student internships and coops; and

4. Prepare existing and prospective K–12 teachers to teach science and mathematics more effectively.

Initiating and supporting cutting-edge research projects provides training opportunities to underrepresented groups on the demands and rigor of working in environments were big science is practiced.

Relevant examples of new research and institutional infrastructure initiatives resulting from SEA efforts include:

- **Minority Information Technology System Service**—This project provides broad in-depth information technology support to the Defense Information Systems Agency (DISA) [http://www.llnl.gov/sea/releases/1999/pvamu.1216.html].

- **Research at the Center for Advanced Microstructures and Devices (CAMD)**—For SEA faculty and students to gain experience in synchrotron radiation research by conducting materials research on existing beamlines and end stations at the CAMD facility [http://www.llnl.gov/sea/releases/2002/camd.0619.html].

- **Community Environmental Justice Awareness Training**—A series of town meetings to educate grassroots organizations and economically disadvantaged individuals, including the youth in the community, about the long-term impact of the release of toxic chemicals into the air, water, and land by industrial facilities [http://www.llnl.gov/sea/releases/2002/epa.0619.html].

- **High Performance Computing and Communication (HPCC)**—A research collaboration on high-performance computing in scientific areas of interest to the U.S. Army. The primary educational goal of the HPCC initiative is to increase the pool of scientists and engineers trained in the effective use of high-performance computing [http://www.llnl.gov/sea/releases/2002/hpcc.0619.html].

- **Scientific Awareness Workshop for Culturally Diverse Colleges and Universities**—A workshop for small and rural HBCUs designed to acquaint the participants with the methods, procedures, and techniques for securing scientific grants, either individually or through cooperative partnerships [http://www.llnl.gov/sea/awareness.html].

These projects give rise to an enhanced and improved research infrastructure at the institution by creating new research laboratories and engaging faculty and students in first-rate conferences and other collaborative interactions with leading practitioners. Additionally, our projects provide hands-on training opportunities for students in grades K–12 through graduate school.

The SEA initiates and supports teacher-student summer internship educational activities. One being the summer program for research teams at SEA partner Lawrence Livermore National Laboratory (LLNL). Here, each team consists of a faculty member and two or more students in the areas of chemistry, physics, molecular biology, optics, and material or environmental science. Over the eleven-year history of the program, new research initiatives have emerged at the academic institutions as a result of collaborations between SEA faculty and LLNL technical staff [http://www.llnl.gov/sea/summer.html].

Through its Student Technical Conference, the SEA continues to support academically strong, talented, underrepresented achievers in the scientific and technological areas. The culminating event is a banquet where the SEA awards scholarships and incentive awards to high school and college students pursuing science and engineering fields [http://www.llnl.gov/sea/transaction.html].

The most recent activity demonstrating our focus on building engineering and science talent for the future involved SEA staff coordinating the travel of a 55-person group to the Kennedy Space Center's (KSC) Center for Space Education in Orlando, Florida. The group consisted of African-American students in grades K-12 traveling from North Carolina (30 students and 15 chaperones), Maryland (three students), Texas (two students), and Georgia (one student). The objective of the trip was to broaden the horizon and extend the vision of youth who normally do not venture beyond their classroom and local environment. The students gained an appreciation for science and engineering as they heard answers to the question "why on Earth do we spend tax dollars on space?" The students and the adults were amazed to learn from NASA officials that "each dollar invested in space programs yields many new products, technologies, and processes

on Earth in areas like agriculture, transportation, environment, energy and natural resources, and health and medicine." [http://www.llnl.gov/sea/news.html]

The SEA supports the development of teachers of science and mathematics in grades K–12 as a means of attracting underrepresented young people into science and engineering. Through its teacher enhancement summer workshops at each institution, the SEA is working with and preparing high school teachers to obtain a greater appreciation for the application of mathematics in science, and for the experience of laboratory and field work. The workshops also provide an opportunity for interaction with practitioners in various fields of science. We believe that effective, confident teachers will be more prone to help and encourage students of all backgrounds to pursue fields like science and engineering [http://www.llnl.gov/sea/teacher.html].

Our work in teacher development led to the creation on each SEA campus Centers of Excellence for Math and Science Teacher Preparation
[http://www.llnl.gov/sea/releases/2002/grant.0610.html].

In March 2002, the U.S. Department of Commerce's National Institute of Standards and Technology (NIST) signed an agreement pledging to partner with the SEA. This new relationship will harmonize and enhance the scientific, technical, and creative resources and talents of the SEA member institutions, and advance the knowledge in the fields of chemical and physical science and engineering while producing top quality graduate and undergraduate students [http://www.llnl.gov/sea/releases/2002/nist.0401.html].

With twelve years of direct experience in facilitating production of scientists and engineers among an underrepresented talent pool matriculating at HBCUs
[http://www.llnl.gov/sea/history.html], SEA expects to continue its focus in this area.

## Lessons Learned

Since inception in 1990, we have learned two valuable lessons of what we believe constitutes "best practices" in building science and engineering talent among underrepresented students at HBCUs:

1. Strengthening the research infrastructure at the academic institution and providing solid mentoring is the foundation for consistently producing science and engineering talent from the K–12 to the graduate level.

2. Sustained partnerships and collaborations built around the faculty, in the long-term, are more beneficial to all participants than summer internships built primarily around students.

Our success supports these findings [http://www.llnl.gov/sea/feedback2.html].

## References


1. American Association for the Advancement of Science (2001) In pursuit of a diverse Science, Technology, Engineering and Mathematics Workforce.

2. American Association of State Colleges and Universities and National Association of State Universities and Land Grant Colleges. (1999) Enrollment Trends at Public Four-Year Colleges and Universities, Fall 1990 to Fall 1997.

3. National Science Board. (1998). Science & Engineering Indicators, 1998.

4. National Science Foundation/SRS, Survey of Earned Doctorates

5. Day, J. (1996). Population Projections of the United States by age, sex, race and Hispanic origin: 1995 to 2050. Arlington, VA: U.S. Census Bureau.


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SEA -- 12 Years as A Unique Resource for the Nation