Archived Information

Mathematics and Science Initiative Concept Paper

Background

The quality of mathematics and science achievement of students in America has been a major area of concern for the last fifty years. Over that time, the federal government launched and participated in a variety of attempts to promote mathematics and science education. Arguably the most illustrious and significant of these occurred after the Soviet Union launched *Sputnik* in 1957. As a response to the Soviet Union's demonstration of superior technological capability, within 12 years of *Sputnik*, America had upgraded its mathematics and science education program, launched satellites, seen its own astronauts orbit the Earth, and landed the first man on the Moon.

It was not until the mid-1980s that the Department of Education recognized the need to reach more students and teachers and began the Eisenhower Professional Development program, followed by the Eisenhower Regional Consortia and the Eisenhower Clearinghouse. The National Science Foundation, meanwhile, worked to broaden the focus of mathematics and science education from a focus on an elite group of students to a focus on all students. NSF made substantial investments in curriculum development, preservice and inservice teacher education, the informal science infrastructure, and uses of technology to enhance K-12 instruction and create systemic reform. In FY 2002, NSF and the Department of Education created the Mathematics and Science Partnerships Program, which began funding partnerships across agencies and institutions to strengthen instruction and improve student learning in mathematics and science.

As federal agencies focused on programmatic efforts, reports from *A Nation at Risk*[i] through the Glenn Commission's *Before It's Too Late*[ii] studied mathematics and science instruction—sometimes as the sole focus, sometimes in a broader context—and offered a variety of observations and recommendations that were rarely sanguine, usually urgent in tone, and which served to focus attention on this area.

While K-12 education in the United States has achieved some small scale successes (*e.g.*, in Maryland, Massachusetts, and Texas;[iii] in North Carolina;[iv] and by the *First in the World Consortium*, based in Naperville, IL[v]), it has also faced significant ongoing disappointments (*e.g.*, flat NAEP[vi] and TIMSS[vii] results, ongoing shortages of teachers well-prepared in mathematics and science[viii], and, since the 1980s, decreasing numbers of college graduates with majors in physical, computer, and earth sciences and in mathematics and engineering, albeit with an overall increase in the numbers in biological and agricultural sciences, as well as the social and behavioral sciences.[ix]). Despite a variety of efforts, there are some important areas where little progress has been made, such as our inability to dramatically improve student achievement in groups—other than females—who have historically been underrepresented in the science, technology, engineering, and mathematics (STEM) pipeline[x]. While there has recently been some grounds for hope that progress is being made in achievement in urban districts, it will require very significant progress to close all the relevant gaps.[xi]

Achievement scores for U.S. students usually fall at or below international averages and have done so for three international comparative assessments of science and mathematics (one of which was repeated—making four comparisons)[xii], the scientific literacy of our young people does not meet levels needed to participate fully as productive citizens in the 21st Century. The pathway to STEM jobs in is not full of people determined to become professionals in these areas, nor is the composition of those remaining on the pathway representative of the group that began the journey.

Where Do We Go From Here?

Taken together, these efforts suggest three overarching points that demand our attention:

- There are still many unanswered questions about how to improve mathematics and science achievement for all students that need answers immediately.
- We need to significantly scale up our successes.
- We need to learn what we can from our failures and from the problems that continue to plague us.

The report *Road Map for National Security: Imperative for Change,* also known as the Hart-Rudman Commission Report, released months before the attacks of September 11, reminds us how critical it is to develop a new generation of citizens who have the understanding and skills in the STEM areas to create new strategies and technologies to keep America safe and prosperous.[xiii] The ability to inspire a new generation of scientists, mathematicians, engineers, and technicians starts in our nation's schools. To call attention to the need to improve mathematics and science instruction across the country, the Administration is launching a major new five-year Mathematics and Science Initiative to improve mathematics and science achievement. The Initiative will focus on three main goals:

1.) **Conducting a broad-based public engagement campaign that draws attention to the need for mathematics and science education in our nation's schools.** Students need to envision where a career in STEM can take them, and to understand that they must prepare now for such opportunities. Parents need to know what children should be studying to prepare them for success in a world that requires the ability to understand and apply knowledge of mathematics and science. And the public must realize that advances in technology and productivity, necessary for the U.S. to remain competitive in the global economy, depend on all students learning more mathematics and science than is currently required, but also on increasing the number of students who extend their mathematical knowledge beyond algebra so they may proceed to more advanced scientific and technical subjects.

    The Initiative will work with the business community and professional organizations of mathematicians, scientists, and engineers (formal and informal), as well as educators, to: (a) sponsor events that excite students and parents about careers in the STEM areas; (b) bring these professionals into schools to work with students and teachers to improve student learning; and (c) send teachers and students to work with STEM professionals as interns, summer or part-time employees, and consultants at the scientific job site. Businesses and federal departments and mission agencies will be involved with educators in providing STEM examples, developing the messages, leveraging the dissemination efforts, and coordinating their programs and materials with state standards and initiatives in mathematics and science.

2.) **Initiating a major campaign to recruit, prepare, train, and retain teachers with strong backgrounds in mathematics and science.** The campaign will seek to accomplish three objectives: increase the number of new entrants to the teaching profession who have a strong background in mathematics and science, strengthen the mathematics and science knowledge of current and future teachers, and retain significantly more of those current teachers who have strong backgrounds in mathematics and science and are effective instructors in those subject areas. Pursuit of the first objective will promote promising alternative routes in the states to recruit such teachers, in addition to strengthening the traditional routes to teacher preparation. Existing federal programs in the U.S. Department of Education (ED), such as Transition to Teaching[xiv] and Troops to Teachers,[xv] will have a special focus on bringing highly qualified recent college graduates and mid-career professionals with strong subject matter background in science, technology, engineering, and mathematics into teaching. It will also focus on working with colleges of arts and sciences in institutions of higher education, as well as teacher training programs, to ensure that tomorrow's K-12 mathematics and science teachers have the high levels of content knowledge so needed for the 21st Century.

The second objective will focus on providing current teachers with effective professional development programs that develop their content knowledge and show evidence of boosting student achievement. The third objective to retain highly qualified teachers in our classrooms will encourage establishing incentives and improved working conditions superior to those currently in common use.

3.) **Developing a major academic research base to improve our knowledge of what boosts student learning in mathematics and science in the classroom**. Teachers need to know what programs and strategies are effective in improving student achievement in mathematics and science. A rigorous research agenda, as mandated in the No Child Left Behind (NCLB) legislation, will be undertaken to specify the learning processes that are essential for success in a wide range of learners, to identify the effective instructional strategies that capitalize on knowledge about learning in mathematics and science, and to effectively transmit that information to the teachers who need it.[xvi] Several areas of inquiry have been identified to develop a scientifically rigorous research base of practical value. Research foci described in this Initiative aim to: identify workforce requirements and citizenship needs related to STEM, understand student learning in mathematics and sciences, explain the dynamics of successful interventions, and develop and apply valid assessment tools to measure progress of students and programs.

Our history is one of successes and failures, of ongoing problems as well as accomplishments. Sometimes our focus has been both clear and strong. At other times federal attention to mathematics and science education has lost focus and waned, particularly where elementary and secondary education are concerned. What follows attempts to make constructive use of our history. We understand that there may not be any major break-throughs to be found and that we must be modest ourselves in the face of the modest impact that has been accomplished through earlier efforts, energy, and expended resources. Nevertheless, we seek to provide resources to support the high demands and rigorous assessments of the *No Child Left Behind Act*. These include a requirement that by 2005, all children will be taught by highly qualified teachers, who demonstrate subject matter knowledge for each course they teach. Further, there are four basic principles to *No Child Left Behind*: Accountability, Local control and flexibility, Greater parental choice, and Research-based practice. These principles require that:

- States create their own standards for what a child should know and learn for all grades. Standards must be developed in math and reading immediately. Standards must also be developed for science by the 2005-06 school year.
- With standards in place, states must test every student's progress toward those standards by using tests that are aligned with the standards. Beginning in the 2002-03 school year, schools must administer tests in each of three grade spans: grades 3-5, grades 6-9, and grades 10-12 in all schools. Beginning in the 2005-06 school year, tests must be administered every year in grades 3 through 8 in math and reading. Beginning in the 2007-08 school year, science achievement must also be tested.
- Each state, school district, and school will be expected to make adequate yearly progress toward meeting state standards. This progress will be measured for all students by sorting test results for students who are economically disadvantaged, from racial or ethnic minority groups, have disabilities, or have limited English proficiency.
- School and district performance will be publicly reported in district and state report cards. Individual school results will be on the district report cards.
- If the district or school continually fails to make adequate progress toward the standards, then they will be held accountable.[xvii]

This initiative is both a national and a federal initiative. The Office of Science and Technology Policy (OSTP), the U. S. Departments of Education (ED) and Energy (DOE), the National Science Foundation (NSF), the National Institutes of Health (NIH), the National Aeronautics and Space Administration (NASA), as well as other federal departments and agencies involved in education and workforce development, will continue to collaborate to promote this Initiative. Clearly there is a need to add coherence to the wide variety of federal efforts in STEM education. The combined efforts should add up to an impact on mathematics and science learning without the pieces losing their appropriateness to the mission of their home agency or department. At the same time, these efforts must be coordinated with the many projects and initiatives underway in the professional, corporate, and foundation communities, as well as in national, state and local education organizations. Once the programs become coordinated and known across the nation, they will be effective in achieving their goals, and in ensuring a workforce and citizenry that can take America successfully to the next century.

Section I: The Need To Increase Public Awareness of the Vital Importance of Mathematics and Science Education

Our nation's education system is failing to equip our children with the essential STEM skills required in an increasingly competitive global economy. Nearly three-quarters of our nation's 4th and 8th graders and nearly four-fifths of our 12th graders are scoring at levels below "proficient" in mathematics and science for their grades.[xviii] International mathematics and science assessments demonstrate that as U.S. students progress through their educations they score progressively worse than do students in the rest of the developed world. Furthermore, national and international benchmarks confirm that minority students and students from low-income families perform particularly poorly in relation to other U.S. and international students. The overall problem of comparatively low rankings by U.S. students on international comparisons was noted at least as long ago as 1983, when the National Commission on Excellence in Education reported that "International comparisons of student achievement, completed a decade ago, reveal that on 19 academic tests American students were never first or second and, in comparison with other industrialized nations, were last seven times."[xix] More recently, the National Research Council's Mathematics Learning Study Committee reported:

> One area in which the research evidence is consistent and compelling concerns weaknesses in the mathematical performance of U.S. students. State, national, and international assessments conducted over the past 30 years indicate that, although U.S. students may not fare badly when asked to perform straightforward computational procedures, they tend to have a limited understanding of basic mathematical concepts. They are also notably deficient in their ability to apply mathematical skills to solve even simple problems. Although performance in mathematics is generally low, there are signs from national assessments that it has been improving over the last decade. In a number of schools and states, students' mathematics performance is among the best in the world. The evidence suggests, however, that many students are still not being given the educational opportunities they need to achieve at high levels.[xx]

In light of poor U.S. student performance in mathematics and science, a national campaign is needed to inform parents, students, educators, and the general public about the importance of mathematics and science learning in our changing society. Strengthened science and mathematics education would contribute to our nation's prosperity by spurring economic growth and generating a more highly skilled workforce. It would also afford greater opportunities for students to pursue postsecondary education and training or to enter higher-wage careers. It would also contribute to democracy's ongoing need for an educated citizenry.

This campaign will also confront negative public perceptions regarding mathematics and science, especially the misconceptions that only "nerds" need to study mathematics and science and that it is acceptable for adults to say that "I was never any good at mathematics." Parents will learn that while they may not have needed a high-level mathematics and science background to be successful, their children will. The Initiative will enlist the aid of state and local education agencies, businesses, professional organizations, religious, and non-profit organizations to promote STEM awareness.

Poor U.S. Student Achievement in Mathematics and Science

- ***One out of every three students in 4th, 8th, and 12th grade performs at the lowest level on the National Assessment of Educational Progress (NAEP) mathematics assessment.*** While trends over the past 10 years show that students have improved their mathematical skills, the proportion of students scoring at the "below basic" level is still 31 percent for 4th graders; 34 percent for 8th graders; and 35 percent for 12th graders. A large majority of students score at the two lowest levels, "basic" and "below basic."[xxi]

- ***A substantial achievement gap between white students and both black and Hispanic students persists in mathematics across a 10-year span despite achievement gains for all three groups. In science a similar gap persists across a 4-year span, but with minor changes in overall achievement levels.*** The U.S. Department of Education's report *The Nation's Report Card: Mathematics 2000* revealed that while white, black, and Hispanic students at grades 4 and 8 made gains on the NAEP since 1990, the large gaps between these subgroups' performance have remained relatively unchanged. In the 2000 assessment, white students, in all three grades, had higher scores, on average, than black or Hispanic students, and the differences in scores were substantial. For example, white fourth graders scored 236, on average, in 2000 compared to 205 for black students and 212 for Hispanic students. In eighth grade the comparable numbers were 286 compared to 247 and 253. These large gaps between subgroups' performance have remained relatively unchanged since 1990. White students had higher scores in 2000 than in 1990 at grade 12, when no significant difference in scores was found for black or Hispanic students.[xxii] In fact, black and Hispanic 12th graders demonstrate a similar set of mathematics skills as white 8th graders in the NAEP, and only 3 percent of minority students score at the proficient level in mathematics. One exception is that when U.S. eighth graders' 1995 TIMSS and 1999 TIMSS-R scores are compared, Black students showed a significant gain in mathematics (but not in science)[xxiii]. In science, NAEP results showed only a few, modest changes between the 1996 results and those of 2000 (this science assessment was first administered to nationally representative samples of fourth-, eighth-, and twelfth-grade students in 1996). There were no significant differences at grade 4; at grade 8, the average score for American Indian students declined; and at grade 12, the average score for white students declined. Across all three grades in 2000, white students had higher scores, on average, than black or Hispanic students. The large gaps between subgroups' performance have remained relatively unchanged since 1996.[xxiv]

- ***8th graders in the U.S. are outperformed in mathematics and science by students in almost all industrialized nations, except Italy and New Zealand.*** The 1999 Third International Mathematics and Science Study–Repeat (TIMSS-R) reports that U.S. students score significantly lower than 8th graders in 14 countries. Singapore students score the highest in mathematics while students from Chinese Taipei score the highest in science.[xxv] Recent analyses of NAEP items, which show that NAEP mathematics standards are lower in comparison to exams given in Singapore. For example, NAEP mathematics items for 8th graders match those given to 5th graders in the Asian city-state.[xxvi]

Mathematics and Science as Spurs to Economic Growth and Competitiveness

- ***Science and mathematics are key drivers in an economy that relies heavily on emerging technologies.*** New technologies facilitate the nation's standard of living by making workers more productive. As noted by The National Commission on Mathematics and Science Teaching for the 21st Century (Glenn Commission), from 1996 to 2000, national productivity increased, on average, by 2.6 percent per year. If we could maintain that rate—all other things being equal—the nation's standard of living would double approximately every 25 years.[xxvii] Recent evidence suggests that improved productivity in the computer-producing sector and the effect of computer technology on workers together account for much of the recent acceleration in U.S. labor productivity.[xxviii] The first wave of technology has enabled the country to do traditional jobs with fewer workers, but it has also increased the number of jobs in new fields that need science, technology, engineering and mathematics workers.

- ***Other nations have stepped up their efforts in creating a well-trained workforce in science and technology, often competing with U.S. workers.*** The Glenn Commission also put us on notice about specific examples of other nations' efforts to upgrade their workforces through enhanced scientific and technological education. Singapore, for example, reputedly has the most technologically intensive workforce in the world. Israel now produces more technology-based startups than anywhere outside Silicon Valley; its high-tech exports account for a quarter of global sales. Drawing on a young, skilled, and well-educated workforce, Ireland now produces 60 percent of all PC business-application software sold in Europe.[xxix]

- ***Many of today's fastest growing jobs require a solid mathematics or science background.*** Of the 20 fastest-growing occupations projected by the U.S. Bureau of Labor Statistics (BLS) through 2010, 15 of them require substantial mathematics or science preparation. Most of the fastest-growing occupational areas will reflect continued growth in computer technology—a field that imports talent in order to stay competitive—and health services. The fastest-growing jobs in mathematics and science fields will increase by nearly 6 million in 2010.[xxx] While the number of young adults 18- to 24-years old will grow by 3 million over this same decade, 56 percent of these adults will be minority students who are underrepresented in higher level mathematics and science classes in high school and college.[xxxi] Increased numbers of H 1 (b) visas have been the nation's response to shortages in highly skilled workers, but when the shortages reach the millions, that solution is no longer viable. Without a considerable investment of time and energy in improving America's K-12 educational system in science and mathematics, American companies will find no alternative but to go overseas to countries that have better skilled workforces.

Greater Opportunities to Attend College and Enter High Wage Professions for Students of Mathematics and Science

- ***Students of all income levels who take rigorous mathematics and science courses in high school are more likely to go to college, and among low-income students (students in the bottom third of the income distribution), the difference is particularly dramatic.*** Students from low-income families who took Algebra I and geometry were almost three times as likely to attend college as those who did not. While 71 percent of low-income students who took algebra I and geometry went to college, only 27 percent of low-income students who did not take algebra I and geometry went on to college. The differences are also dramatic among students from middle- and high-income families: 94 percent of students from high-income families, and 84 percent of students from middle-income families who took algebra I and geometry went on to college, while 60 percent of students from high-income families and 44 percent of students from middle-income families who did not take algebra I and geometry still went on to college.[xxxii] This study demonstrates how critical it is for teachers to have high expectations for their students and to ensure that all students take these courses and succeed.

- ***The earnings of young adults with at least a bachelor's degree increased over the past 20 years relative to their counterparts who have less education***. Adults ages 25-34 with at least a bachelor's degree have higher median earnings than those who have less education. In 1980, male college graduates earned 19 percent more than those who completed only high school or a General Education Development Certificate (GED). By 2000, the earnings difference was 60 percent. The gap in the last 20 years has widened for females as well. In 1980, female college graduates earned 52 percent more than those who completed only high school or a GED. By 2000, the earnings difference was 95 percent. The earnings gap is even wider between college graduates and those whose highest education level was grades 9-11. In 1980, males whose highest education level was grades 9-11 earned almost 50 percent less than male college graduates. By 2000, the earnings difference was 87 percent. In 1980, females whose highest education level was grades 9-11 earned almost 90 percent less than female college graduates. By 2000, the earnings difference was 125 percent. [xxxiii]

- ***Many of today's occupations require solid math skills.*** Economists Richard Murnane and Frank Levy constructed a rough equivalence between basic workplace requirements and NAEP scores. These workplace requirements were based on employer data on tests given to candidates applying for new frontline jobs. For example, an applicant for a production associate's job at a modern automobile plant would have to score roughly 300 points or higher on the NAEP math test to meet company proficiency requirements. However, almost half of all 17-year-olds cannot do math at that level and lack the skills necessary to earn a middle-class paycheck.[xxxiv] Firms are hiring based on applicant knowledge of basic math skills.

- ***Students with higher-level mathematics skills earn more.*** Even among students who only earned a high school diploma, those with highest-level mathematics skills earned more than double (108 percent more) than those with the weakest skills.[xxxv]

- ***Scientists and engineers earn higher salaries and are employed at very high rates.*** The median annual salary of scientists and engineers in 1997 was $52,000 for bachelor's degree holders and $59,000 for master's recipients. By comparison, the median annual salary of individuals employed in non-science and engineering fields in 1997 was $40,000 for bachelor's degree holders; $50,000 for master's recipients. The unemployment rate was 1.5 percent for all workers in science and engineering occupations in 1997, while the national unemployment rate was 4.8 percent. [xxxvi]

- ***In the computer science field, jobs will outpace the number of related degrees earned by new college graduates in the U.S.*** The U.S. Department of Labor estimates that postsecondary institutions will have to produce nearly four times as many graduates in computer science as they do now to meet the labor demand by 2008. In 1998, 29,345 college graduates received a bachelor's degree in computer science.[xxxvii] To mitigate the shortage of skilled workers in the U.S., the H1-B visa was established in 1990 to permit employer-sponsored foreign workers with a college degree or higher to work in the United States for a renewable three-year term. Subsequent legislation raised the ceiling on the number of international workers allowed under the visa program based on increased labor market demands.[xxxviii] In 1999, the limit of 115,000 workers was reached in June of that year.

Student and Public Perception of Mathematics and Science

- ***Public opinion calls for better science education in schools.*** Ninety-three percent of Americans say students need stronger education in science to be prepared for the new inventions, discoveries, and technologies that increased investment will likely bring. In fact, 85 percent agreed that improving pre-college science education in their state should be one of their governor's top priorities.[xxxix]

- ***College students wish they had a stronger pre-college mathematics and science education.*** Forty percent of college students say they wish they'd had a stronger pre-college science and mathematics education. Seventy percent believe science and mathematics education should be strengthened for the next generation of students.[xl]

- ***The need for higher-level STEM skills and understanding will only grow.*** At least one source cited by the Glenn Commission believes that some 60 percent of new jobs in the early 21st century will require their holders to have skills currently mastered by only 20 percent of those in the workforce.[xli]

Section II: Recruit, prepare, and retain teachers with strong mathematics and science backgrounds

There is a serious shortage of effective teachers of mathematics and science who meet the current definition in the No Child Left Behind Act of "highly qualified."[xlii] While many of the current teachers of science and mathematics completed the work required for certification at the time of their entry into the profession, they must now complete the coursework, major, or demonstration of knowledge to show that they will meet the current definition. Research suggests that mathematics and science teachers who have strong content knowledge in the area they teach have a positive impact on student learning.[xliii] Research also indicates that teacher quality is the single most important factor in school quality.[xliv]

As states and local districts have searched for solutions to meet the need for mathematics and science teachers with strong content knowledge, they developed a variety of options. Some states and local districts worked with the their colleges and universities to recruit and prepare more teachers in shortage areas. States have also required that principals not place teachers in classes for which they are not certified and required principals to send letters to parents where that occurs. In addition, states and local districts have created alternative certification programs (ACP) that bring professionals from other fields into teaching. In many cases, this provided teachers who had strong backgrounds in either mathematics or science. In testimony to the House Committee on Education and the Workforce Subcommittee on Postsecondary Education, Training and Life-Long Learning on May 13, 1999, Emily Feistritzer stated "The National Center for Education Information (NCEI) has been polling the state departments of education annually since 1983 regarding teacher education and certification. We have found a rapid development of alternative routes at the state level. By 1998, 41 states, plus the District of Columbia, report having some type of alternative teacher certification program. It is estimated that more than 80,000 persons have been licensed through these programs. Thousands more are being licensed to teach who are participating in college alternative teacher preparation programs."[xlv]

Other options to create alternative routes into teaching have been explored as well. For example, Teach for America (TFA) recruited majors in content areas and, when they are assigned to secondary schools, made the assignments compatible with their majors teach in under-resourced urban and rural schools. These young people from prestigious colleges and universities attended summer training and promised to teach for two years.[xlvi] New options are being created in states such as Louisiana to allow candidates who complete approved recruitment programs or who pass tests from entities such as the American Board for Certification of Teacher Excellence, to move directly into teaching as fully certified teachers.[xlvii] While all of these options exist, the common need is to provide every child with a teacher who is highly qualified in the knowledge and skills of the content area taught.

The goals of this Initiative are to improve the quality of mathematics and science teachers entering the profession, increase content knowledge and teaching skills of current teachers of mathematics and science, and establish mechanisms to retain highly qualified teachers of mathematics and science in K-12 schools. A report issued in 2001 by the American Mathematics Society, the Mathematics Association of America, and The Conference Board of Mathematics Sciences points out that there is an important role for university mathematics departments in actively supporting teacher education.[xlviii]

The Mathematics and Science Partnerships Program authorized under Title II of *The No Child Left Behind Act* will bring together state education agencies, colleges of arts and sciences and of engineering, local school districts, and community-based organizations to focus on effective practices that can be replicated across the country. The program will fund a variety of activities including in-depth training of pre-service and in-service teachers in mathematics and science, the identification and use of rigorously researched mathematics and science curricula and distance learning programs, and incentives to recruit and retain college graduates with degrees in the STEM areas. In FY 2003, NSF received $126.67 million and ED $101 million for the program.

The Need for Mathematics and Science Teachers

- ***Projections show a need for over 2 million new teachers in this decade,[xlix] of which 240,000 will be middle and high school mathematics and science specialists.[l]*** These numbers may actually be an underestimate. The ED report *Predicting the Need for Newly Hired Teachers in the United States to 2008-09*, provides three scenarios on which to base projected need for teachers for population growth. The scenario resulting in the estimated need for 2.2 million teachers was the most conservative, assuming a constant need for teachers over the period 1998-99 through 2008-09. A second scenario is predicated on the assumption that pupil/teacher ratios will not change, but that enrollment will increase. The latest projections by the U.S. Department of Education's National Center for Education Statistics (NCES) show the total K-12 enrollment increasing slowly from 52,902,000 in fall, 2000, to 53,397,000 in fall, 2005, and then decreasing to 53,026,000 in fall, 2011. The projection for fall, 2008, is 53,125,000.[li] These figures support the assumption of a modest increase in student enrollment. This lends support to this second scenario, which projects a need for 2.4 million new teachers. The third scenario assumes both increasing enrollment and decreasing pupil/teacher ratios. Its projection is for a need for some 2.7 million teachers by 2008-09. Budget and other factors could and will affect the outcome and help determine the eventual need, but that need is substantial. For middle school mathematics and science specialists, proportionate increases would result in the need for either some 260,000 or for over 290,000 new teachers.

- ***State-level reports on staffing needs indicate high levels of need for mathematics and science teachers in over three fourths of the states issuing such reports.*** Of the 39 states reporting teacher shortages for the National Association of State Boards of Education's 2002 issues brief on state incentives in recruiting teachers, 31 reported a shortage of mathematics teachers and 30 reported a shortage of science teachers. The mean level of need was 3.77 on a 4-point scale, where a rating of 4 was described as "great need and a rating of 3 was described as "moderate need."[lii]

Current State of Teacher Quality

- ***Teacher quality linked to student value-added mathematics performance.*** Researchers used data from two Tennessee districts to identify the "effectiveness" of teachers, based on the average annual performance of students in their classes. When students were assigned to three highly effective teachers in a row, these students scored at the 83rd percentile in mathematics at the end of 5th grade. However, when students were assigned to three ineffective teachers in a row, they scored at the 29th percentile in mathematics.[liii]

- ***A sizeable number of mathematics and science teachers do not have a major or minor in their field, especially those who teach in high-poverty and high-minority schools, despite research that indicates the importance of teachers' subject-matter knowledge to student outcomes.*** The percentage of mathematics teachers without a major or minor in mathematics has remained high for middle school teachers. In 1999-2000, a majority of middle school mathematics teachers (51.5 percent), and a large percentage of middle school science teachers (40 percent) lacked either a major or minor in their field. These figures are virtually identical to those of 1993-94 of 50.3 percent and 39.2 percent, respectively. High school mathematics and science teachers are better prepared than are middle school teachers, although the share of high school teachers who lack adequate preparation has risen since 1993-1994. For example, in 1999-2000, 14.5 percent of high school mathematics teachers and 11.2 percent of high school science teachers lacked a major or minor in their field as compared to 11.6 percent and 7.6 percent respectively in 1993-94.[liv]

- ***On average, mathematics or science teachers at all levels scored lower on the mathematics section of the SAT compared to mathematics or science majors not interested in teaching.*** As a group, teachers of mathematics or science scored 557 on the mathematics section of the SAT, below the average score of 593 for mathematics or science majors who do not go into the teaching profession.[lv] Mathematics teachers at all levels scored 568 on the mathematics section of the SAT, whereas mathematics majors not going into the teaching profession scored 624.[lvi] In addition, only 21 percent of mathematics majors go into the teaching profession and teach mathematics, and a much smaller proportion (8 percent) of mathematics majors become teachers of a subject other than mathematics. In other words, the vast majority of mathematics majors (71 percent) choose not to go into the teaching profession.[lvii]

Licensing Requirements

- ***Several states do not require secondary teachers to take a licensing examination in their subject, and a few do not require teachers to take any licensing examination.*** Although 44 states require candidates for secondary licenses to take some kind of licensing examination, only 29 require them to take tests in the subject area they will teach. [lviii] The main teacher certification examinations, the Praxis and National Evaluation Systems, cover content that can be found in a broad high school curriculum. Only a few questions go beyond calculus or address concepts typically learned in the first two years of college.

- ***Many states allow prospective mathematics teachers with relatively low scores on licensing examinations to become teachers.*** Of the 29 states that use the Praxis I exam, a basic skills test, most states set their minimum cut scores in mathematics around the 20th-

40th percentile range.[lix] Virginia is the only state that sets its minimum score at the 50th percentile. Of the 5,000 Virginia teacher candidates who took the PRAXIS I, 35 percent failed the mathematics portion. In areas of short supply, states may still require candidates to take the test but will waive the requirement for minimum performance.

- ***There is agreement on the need for teachers of mathematics to have a stronger mathematics background.*** Specific teacher knowledge about elementary, middle, or secondary school mathematics that has been shown to enhance the effectiveness of instruction should be demonstrated by teacher candidates, either by college-level coursework or examination. In addition, the training of mathematics teachers should include practica on the use and delivery of mathematics curricula and lessons that are representative of those widely used in the nation, or in the state in which the teacher is being trained.

Teacher Salaries

- ***Beginning teacher salaries have continued to improve, with an average annual salary of $29,000 in 2000-01; however, new college graduates are receiving offers exceeding those made to beginning teachers by $10,000 or more per year in other fields.***[lx] Although the pay gap narrowed in the early 1990's, it began to widen again after 1996. While beginning teacher salaries increased by 4 percent in 2000-01, salary offers to other new college graduates increased by 7 percent. Further, the average teacher salary continues to fall well below the average salaries of other professional occupations. For example, while mid-level accountants earned an average of $52,664; computer system analysts, an average of $71,155; and engineers, an average $74,920; teachers averaged $43,250 in 2001.[lxi]

- ***Teacher salaries vary slightly by college major.*** Compared to teachers who majored in general elementary education, teachers with more specialized majors generally received a very slightly higher salary. Mathematics majors earned 2.4 percent more than general elementary education majors. However, teachers who majored in education with an emphasis on physical education earned 4.9 percent more; music majors earned 4.0 percent more; and education majors with an emphasis on vocational education earned 3.0 percent more.[lxii]

- ***College graduates who majored in math or science received considerably higher starting salaries than those who majored in education, and the salary differentials grow over time.*** The average starting salary for an education major was $20,443 in 1994; the starting salary for those who majored in mathematical/physical sciences was 27 percent higher ($25,958); in computer science it was 44 percent higher ($29,428); and in engineering/architecture it was 57.6 percent higher ($32,217). After three years, the salary differentials increased by a much larger extent. The 1997 salary of those who majored in education was $24,543; whereas the salary for engineering/architecture majors was 74.9 percent higher ($42,931) and computer science majors was 81.8 percent higher ($44,624).[lxiii] [lxiv] [lxv]

- ***One of the ways that states and school districts are attempting to attract both new and experienced employees (both teachers and those changing careers into teaching) is through the use of differential pay and other incentives***. While there is little research yet completed on the effectiveness of incentives, there are many being used. These include targeted salary increases (in a variety of states), bonuses (Maryland, Massachusetts, New York, and South Carolina), housing incentives (Baltimore, Santa Fe, Seattle, California, Connecticut, Mississippi), tuition assistance (many states), and tax assistance (California, Maryland)[lxvi]. States, districts, and others are evaluating the effectiveness of incentives and pay differentials. Nevertheless, the evaluations and research under way should prove helpful. As a document prepared for the American Association of School Administrators (AASA) on financial incentives notes:

> One of the reasons policymakers have been somewhat cautious about creating financial incentives targeted specifically to hard-to-staff schools is that they are not sure how effective differentiated-pay systems are. Because incentive programs are fairly new and limited data are available to gauge their usefulness, this strategy is largely untested. Moreover, some argue, it is not clear whether teachers will respond in predictable ways to monetary incentives because good teachers are drawn to the profession by teaching's intrinsic rewards—in other words, "the best teachers aren't in it for the money."[lxvii]

One well-studied program that has been effective in increasing the state's supply of mathematics and science teachers is the North Carolina Teaching Fellows program.[lxviii] Upon acceptance of the program's scholarship, each student agrees to teach for four years following graduation from college in one of North Carolina's public schools or United States Government schools in North Carolina. While this is viewed as payback for the financial assistance tendered, it also provides an element of stability where each teacher may stay in one place long enough to build bonds with students, staff, and community.

Salaries are an important factor in efforts to retain experienced teachers. A study of schools in Texas found that salaries do matter in the battle to retain teachers. Longitudinal data from 1976 to 1996 on public school teachers in the state suggest, "Minority teachers tend to display a greater sensitivity to pay and working conditions, especially in high-risk districts." The authors argue that teacher pay, more than an increase in aides and support staff or a decrease in student/teacher ratio, holds the most promise for teacher retention.[lxix] The AASA report argues, "…money clearly matters…if salary is viewed as just one of many factors that employees weigh…. Salary matters less when other characteristics of the workplace are personally or professionally satisfying. When they are not satisfying or the work itself is significantly more demanding, salary matters more and can be the tipping point that determines whether teachers stay or leave."[lxx]

- ***Mathematics and science teachers with high ACT scores are choosing to leave teaching at higher rates than those teaching in other fields***. A study of public school teachers in Missouri found that for both men and women, the attrition of math and science teachers who had high ACT scores is higher than the attrition of teachers in other fields. Additionally, among women, math and science teachers are much less sensitive to pay differences than elementary teachers, meaning that larger pay increases will be necessary to keep math and science teachers from leaving the profession.[lxxi]

Lack of Rigor in K-12 Mathematics Coursework

- ***U.S. mathematics coursework lacks the rigor of our higher-scoring competitors.*** One study estimates that "hard problems" on NAEP 8th grade assessment are equivalent to 5th grade questions on Singapore mathematics assessments.[lxxii] However, very little research has been directed towards identifying the necessary content that must be introduced and learned at each grade level to ensure success at the next level.

- ***U.S. schools are much more likely to allow calculators in the early grades than schools in highest mathematics achieving countries.*** Singapore, Korea, Japan, Chinese Taipei, and Hong Kong all score high on international mathematics exams and each restricts or prohibits calculator use in the elementary grades until mastery has been demonstrated.[lxxiii] In addition, fourth graders who used calculators more frequently in their classrooms had lower scores on the 2000 National Assessment of Educational Progress in Mathematics.[lxxiv] According to the Public Agenda's 1997 survey, "seventy-three percent of teachers want students to memorize multiplication tables and do mathematics by hand before using calculators. Eighty-six percent of the public shares this view."[lxxv]

Professional Development

- ***When professional development is focused on academic content and curriculum that is aligned with standards-based reform, teaching practice and student achievement are likely to improve.*** Cohen and Hill[lxxvi] "compared the effects of teacher participation in professional development specifically targeted to a mathematics education reform initiative in California to teacher participation in special topics and issues workshops that were not linked to the content of the mathematics initiative (*e.g.*, workshops in techniques for cooperative learning). The more time teachers spent in targeted training on the framework and curriculum of the mathematics reform, the more their classroom practice changed in ways that were consistent with the mathematics reform, and the more they learned about the content and standards for that reform. Teachers who participated in special topics and issues workshops showed no change in their classroom practice or knowledge related to the reform. Teachers who participated in the focused training and whose classroom practice moved towards incorporating the framework of the new mathematics initiative had students who scored higher on a test of the mathematics concepts imparted by the new curriculum. This study and others suggest that when professional development is focused on academic content and curriculum that is aligned with standards-based reform, both teaching practice and student achievement are likely to improve."

- ***While science, technology, engineering, and mathematics (STEM) faculty in institutions of higher education (IHEs) have the content knowledge that is needed, they may not be aware of the new demands on K-12 teachers or know how to convey that information to teachers in a usable form.*** The National Research Council's study *Transforming Undergraduate Education in Science, Mathematics, Engineering, and Technology*, found that STEM faculty not only are often unaware of changes and developments in K-12 STEM education, they also are not prepared to teach K-12 teachers about teaching at the elementary or the secondary levels.[lxxvii]

Section III: Developing A Comprehensive Research Framework On Mathematics And Science Learning And Assessment

The goal of raising student achievement lies at the very center of the NCLB Act. The research portion of the mathematics and science Initiative is designed to establish a foundation of scientifically based knowledge upon which efforts to improve student achievement levels in mathematics and the sciences may be based. Consistent with the aims of NCLB, this research will generate knowledge needed to help students develop mathematical and scientific proficiency. Research in support of this Initiative must generate scientific knowledge that describes how all students can best learn mathematics and science across different grade levels. .

The 1990's saw multiple efforts to reform mathematics education in order to improve students' performance and to narrow the achievement gaps. Many of these reform efforts have been criticized, however, for both their instructional approaches and the content of the curricula. Critics have charged, for example, that many of the reforms have de-emphasized learning basic mathematics facts and mastery of standard algorithms, encouraged inappropriate dependence on calculators, and relied too heavily on student-directed, discovery learning strategies. Proponents of the reforms counter that traditional approaches over-emphasize memorization of basic mathematics facts and procedures to the neglect of children's conceptual understanding of mathematics. At issue, fundamentally, are what constitutes mathematics proficiency and which teaching methods support student achievement of this proficiency. While there has been much debate, very little empirical research has been conducted to determine if one approach or another or some combination of approaches leads to improved mathematics achievement in general—or to improved algebra performance in particular—across ethnic, racial, and socioeconomic groups in our country.

While not aimed exclusively at mathematics and Science learning, research in the cognitive sciences has provided a steadily growing knowledge base over the past couple of decades on how learning in general takes place. Much of this research was summarized in the National Research Council report, *How People Learn.*[lxxviii] Insights that emerged from this work suggest:

1. Taking student preconceptions into account when teaching a particular body of content.
2. Addressing both factual knowledge and an organizing framework to facilitate retrieval of knowledge and its application.
3. Encouraging a meta-cognitive approach that helps students take control of their own learning by defining learning goals and monitoring their own progress.

Lack of Sufficient Research on What Works in Mathematics and Science

Coordinated and sustained investments in the improvement of mathematics education have been inadequate. Although educational research has provided some important insights into student learning, teacher development, and teaching strategies and technologies that enhance achievement in mathematics, the research has lacked a convergent knowledge base that can support systemic reform. The limited use of educational research and development (R&D) for improving practice can be attributed in part to under-investment in R&D and the consequent fragmentation of the current research effort in reading, mathematics and science.[lxxix]

Two recent national reports call for heightened research attention to the area of mathematics learning and learning difficulties. In 2001, the National Research Council (NRC) of the National Academy of Sciences published *Adding It Up: Helping Children Learn Mathematics*.[lxxx] Comparing remediation in mathematics to that in reading, the NRC committee pointed out that there are few supplementary interventions and little targeted enrichment in mathematics that can help students overcome specific difficulties. Furthermore, they noted that after a certain point, reading requires little in the way of explicit instruction, while the learning of new and unfamiliar topics in mathematics continues to require assistance from teachers and textbooks. The committee also emphasized the crucial importance of school-based instruction for math, given that children are likely to spend little time voluntarily exercising mathematics skills outside the classroom. In March 2002, the Rand Mathematics Study Panel, supported by the Office of Educational Research and Improvement (OERI), US Department of Education, distributed a draft report for comment. This report, *Mathematical Proficiency for All Students: Toward a Strategic Research and Development Program in Mathematics Education*,[lxxxi] also emphasized the need for substantial research to develop an empirical base of evidence upon which new interventions can be based. It also called for research on their effectiveness once new interventions are designed and implemented. The Rand report cites previous research efforts in mathematics education as fragmented, disconnected from problems of practice, and non-cumulative. In a call for well-conceived interventions, the report states that efforts at improving mathematics education often proceed without adequate evidence and independent of theory about promising courses of action.

Improve the Research of Mathematics and Science Education

The research portion of the Mathematics and Science Initiative is designed to establish a foundation of scientific evidence upon which efforts to improve student achievement levels in mathematics and the sciences may be based. Undoubtedly, a comprehensive framework for research on mathematics and science learning and assessment will require collaborative efforts among federal agencies, foundations, universities, and the private sector.

The following list includes several important research domains that have been identified as priority areas in order to achieve the objectives of this initiative. ED, NSF, and the National Institute Of Child Health and Human Development (NICHD), NIH currently fund research in many of these areas.

Cognitive foundations of mathematics and science learning

Basic knowledge of how people acquire, process, and apply scientific and mathematical knowledge is fundamental to the development of effective educational practice. Research that produces scientifically credible findings about student cognition, motivation, and development in mathematics and sciences will provide a foundation of knowledge to inform educational practice and will fulfill part of the mandate of the NCLB Act. Research in this area will focus on identifying the cognitive and motivational processes that under gird the acquisition and maintenance of proficiency in mathematics and the sciences. Federal research programs, such as NSF's programs in Developmental and Learning Sciences and Cognitive Neuroscience and ED's Cognition and Student Learning program support research in this area.

Identify effective interventions in mathematics and science education

Research that investigates specific teaching methods and curriculum materials will help identify the most effective instructional approaches. Effective instruction requires teaching methods and instructional materials that are appropriate to the ability and maturity of the students. Work in this area will identify the instructional conditions under which students from varying abilities and backgrounds learn mathematics and science. Based on available evidence, key areas crucial for supporting mathematics and science education include approaches to instruction and curricular content and format. A primary goal of ED's research agenda is to provide schools with scientific evidence of the effectiveness of interventions in mathematics and science by supporting systematic research on the effectiveness of educational interventions. ED, NICHD, and NSF have engaged in a collaborative research program that supports research examining the conditions under which evidence-based educational interventions in mathematics and the sciences succeed when applied on a large scale.

Identify effective models for training mathematics and science teachers

Research in this area will examine the effectiveness of different models of selection, training, and professional development of mathematics and science teachers. Appropriate targets for research include the effects of different routes of entry into teaching, the different skills and abilities that are required to teach mathematics and science at different levels and for different types of students; the form and duration of pre-professional coursework that is optimal for different types of teaching; the role of induction experiences, field work, and ongoing professional development in developing effective teachers; the effects of differentiated staffing on the effectiveness of instruction at different levels of K-12 education; and mechanisms for teacher recruitment and retention. This research area is central to the mission of the Department of Education.

Develop and evaluate technologies that can advance and extend student learning

Mathematics and science learning are areas in which learning applications that allow students to go beyond the restrictions of their classroom and teacher need to be expanded and evaluated. Because many areas of mathematics and science learning require students to be engaged in ways that are difficult to arrange in traditional classroom instruction, this area of work will focus on ways to deliver individualized instruction that is sensitive to student’s abilities, levels, and approaches to learning. In addition, the impact of innovations such as on-line homework and distance education need to be evaluated more thoroughly.

Develop reliable and valid assessments of mathematics and science learning
Carefully developed assessment tools are required to judge the progress of students, schools, and the nation, in achieving higher levels of proficiency in mathematics and science. Building on knowledge of the foundations of mathematical and scientific competence, research on assessment will develop and test the technical adequacy (*i.e.*, psychometric properties) and practical utility (*e.g.*, instructional applications) of tests designed to assess proficiency levels in mathematics and science education. ED is supporting research that addresses this need.

Understand how to organize schools and design instructional policies
Work in this area will examine how the organization of schools in the form of instructional leadership, staff involvement, school and class size, scheduling of opportunities for learning; parental and community support; and accountability systems within schools affect student outcomes. Research will also investigate the effects of different district- and state-level policies such as alignment of standards and accountability systems and different forms of performance compensation. ED recognizes the importance of studies addressing this need.

Understand student disabilities that hinder mathematics and science learning
Learning disabilities now account for more than half of all students enrolled in special education. NICHD supports research that explores the cognitive, perceptual, behavioral, genetic, hormonal, and neurobiological mechanisms that are influential in the expression of mathematical learning abilities and learning disabilities, predictors of disabilities, and the development of preventive and treatment approaches to ameliorate mathematics-related learning disabilities.

Identify the competencies essential for a workforce well trained in mathematics and the sciences
Much mathematics and science education is based on assumptions about what students need to know that are drawn from professional consensus. These assumptions are then incorporated in standards documents such as those created by the National Council of Teachers of Mathematics. Another route to setting standards and expectations is empirically derived, based on an analysis of the competences that are required to perform mathematical and scientific tasks as they are encountered in the world of work. This aspect of the Mathematics and Science Initiative research goal will identify the areas of mathematical and scientific knowledge required for professional competence in a variety of areas. It will also identify specific content knowledge and skills needed to work in professions designated as “high-need.” In addition, research in this area will examine equity of educational access and investigate ways of improving the diversity of the workforce and professions that rely on mathematical and scientific skills.

Furthermore, research will help determine the kinds of mathematics and science skills needed by individuals who, after being in the workforce, make career changes that require more detailed knowledge of these domains.

A comprehensive research program on mathematics and science learning will require support from foundations, universities, and the private sector in addition to federal agencies. One goal of the mathematics and science Initiative is to develop strategies for more effective collaborative efforts and information sharing across these entities.

Section IV: Action Plan

In order to sustain a national initiative to improve the quality of student achievement in mathematics and science, the Department and its partners must create an integrative, coherent, long-term strategy. Working with other entities concerned about the quality of mathematics and science achievement, the Administration will focus the myriad of activities currently underway on solutions for the problems identified with the quality of teaching and learning. In addition, the Initiative will engage organizations across America to develop the motivation and perseverance of students in the pursuit of study and careers in mathematics, science, engineering and technology.

Planning the Initiative

- Working with the White House Office of Science and Technology Policy (OSTP), ED, NSF, NIH, and NASA conducted an initial forum with other cabinet departments and mission agencies to discuss the Initiative and determine current activities underway in each entity that could be aligned to the Initiative.

- The Department has met with representatives of a cross section of education groups, business/professional groups, informal science groups, universities, business/higher education forums, and community-based organizations to discuss the Initiative and determine current activities underway in each entity that could be aligned to the Initiative.

- Participants from the Secretary's Summit on Mathematics on February 6, 2003, have met in a follow-up session held March 13, 2003. They broke into several small groups and worked on one of the three goal areas of the initiative. Each group completed a needs assessment and began the planning that will result in an integrative, coherent long-term strategy and a set of action plans for each of the goals.

- A second follow-up meeting is planned for May 6, 2003. The groups working in each goal area will make use of the notes and needs assessments from the March 13 meeting and the syntheses/preliminary plans developed by planning teams to draft plans.

Initial Initiative Activities

- In the winter of 2003, the Initiative held the first of a series of seminars/forums with researchers and promising practice practitioners to discuss the current state of research in mathematics and science education and provide opportunities for educators applying scientifically rigorous research-based practices to share their programs.

- The Education Department staff has worked to integrate the Mathematics-Science Initiative with other NCLB education efforts to improve the quality of teacher preparation and teacher development:
  - The Mathematics and Science Partnerships Program will inform the Initiative and be informed by the research findings on effective professional development strategies
  - Teacher quality efforts will build on dissemination of research findings on effective practices in mathematics and science education to states and districts
  - STEM professionals will develop consensus on what should be included in the pre-service course work and in-service professional development for teachers of mathematics and science

- Organizations engaged in mathematics and science research and education will assist in the development of specifications and recommendations for state assessment development efforts

Long-Term Initiative Activities

The impact of the Initiative will depend upon the creation and dissemination of definitive strategies that can be implemented at schools across America to improve the quality of teaching and learning of mathematics and science.

Increasing Public Engagement in Mathematics and Science Education

- The Education Department will fund the establishment of a national center to create state scholars programs and engage the business community in each state to encourage young people to enroll in a rigorous high school course of study, including at least three years of mathematics and three years of science.

- A team made up of representatives of education groups, business/professional groups, informal science groups, universities, business/higher education forums, and community-based organizations will develop and disseminate a series of messages for students, parents, and the public about the need for students to study mathematics and science for improved decision making as well as careers in STEM fields.

Improving Teaching and Learning in Mathematics and Science

- To improve future rounds of applications for funding for the Mathematics and Science Partnerships Program (MSP), ED and NSF trained university and school district partners about the requirements and expectations of the grant program and hoped to stimulate the development of high-quality projects.

- With the feedback to initial applicants, as well as outreach to educate the community, future rounds of MSP grants should result in higher quality proposals that can serve to identify best practices in mathematics and science education.

- The Administration will convene university presidents; deans of colleges of education, of arts and sciences, and of engineering; chief state school officers; and school district superintendents to initiate conversations regarding collaboration in the improvement of mathematics and science education.

- The Administration will support through Fund for the Improvement of Education grants that focus on the content and pedagogy needed by teachers in elementary, middle, and high schools to ensure that students develop the foundation knowledge and skills for success in mathematics and science.

- A PreK-20 team will identify strategies to increase the mathematics and science pipeline from Pre-Kindergarten through post-doctoral studies. The professionals who teach at each level must communicate to ensure that early experiences establish the foundation for later learning. This will enable universities and school districts to influence the preparation of new teachers as well as the professional development of current teachers at every level.

- Parents and students, as well as teachers, will learn about the relationship between early course-taking decisions and later career opportunities.

Expanding the Research Agenda in Mathematics and Science Education

- Phase I of the research component will focus on developing a synthesis of available evidence to inform the effort to improve student achievement in mathematics and the sciences. These activities will provide guidance for immediate efforts to raise student achievement and identify specific knowledge gaps in research that supports the improvement of student achievement in mathematics and science. Phase I activities will include meta-analytic and comprehensive reviews of research and programs meant to support the national effort to improve student achievement in mathematics and the sciences.

- Phase II will focus on the systematic development of a comprehensive, coordinated, interagency research agenda that will develop a foundation of scientific knowledge needed to improve student achievement in mathematics and science and the assessment of current research knowledge. This endeavor will include the efforts of foundations, universities, the private sector, and federal agencies and result in the initiation of new programs of research designed to produce an evidentiary foundation to improve student achievement in mathematics and the sciences.

Action Plans

- From May 6, to June 30, 2003, working teams will develop formal action plans in each of the three goal areas.

Performance Measures

The ultimate purpose of this Initiative is to increase the achievement of students in mathematics and science as stated in the ED Strategic Plan for 2002-2007.

ENDNOTES

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[xv] See Website http://www.ed.gov/offices/OESE/SIP/programs/ttt2.html

[xvi] See Website http://www.nochildleftbehind.gov/

[xvii] See Website http://www.nochildleftbehind.gov/next/overview/index.html

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