The Aerospace States Association

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March 2006

Dear Friend:

I am happy to provide materials presented at the Aerospace States Association hearing on February 8, 2006 in the Rayburn House Office Building in Washington, D.C. This was one of a series of public programs sponsored by ASA, a bi-partisan organization whose Lieutenant Governor and other Governor-appointed delegates represent the grassroots of American aerospace.

NASA and other government officials and representatives of educational associations presented testimony on K-12 science, technology, engineering and math (STEM) education. Speakers emphasized the importance of this education at all grade levels. They also addressed the challenges facing educators who are implementing programs in an already crowded curriculum.

ASA believes that STEM education is critical to America's competitiveness in science and technology—and specifically, aviation and space. We encourage you to consider the information presented in the enclosed hearing documents as you implement education improvements in your state.

For more information about ASA, please visit our website at www.aerostates.org or contact our executive director, Charles Huettner, at (202) 257-4872.

Sincerely,

Loren Leman
Lieutenant Governor, Alaska
Chairman, Aerospace States Association

Enclosure

Aerospace States Association
Overview

"Aerospace is an important part of our lifestyle, economy and security. It has helped define us as a nation and represents America's initiative, ingenuity and fortitude. The Aerospace States Association has a unique role in ensuring this vital industry remains relevant and competitive.

The Aerospace States Association (ASA) is comprised of Lieutenant Governors and state-appointed delegates, including science advisors, industry experts, educators and others with an interest in enhancing education outreach, economic development opportunities and global competitiveness. ASA is an effective vehicle for the formulation of ideas, initiatives and partnerships to benefit member states and their aerospace industries."

Alaska Lieutenant Governor Loren Leman, ASA Chairman

The Aerospace States Association (ASA) is a grassroots representative of U.S. aerospace interests. It is the nation's only aerospace advocacy organization with direct ties to the executive branch of state government.

ASA is a 501(c)(3) non-stock, charitable, education and scientific organization. It functions with governor-appointed delegates from membership states to:

- Provide a state-based perspective on relevant federal programs;
- Preserve and increase the aeronautics and space sectors of the United States;
- Develop and support initiatives that enhance student, teacher, and general education in space and aeronautics;
- Work with individuals and groups throughout the private sector to advance successful economic and scientific policy pertaining to aeronautics and space;
- Support policies that encourage commercial access to, and development of, space;
- Support policies that maintain and enhance the United States' leadership in aircraft and aircraft component manufacturing and that improve safety and efficiency of air transportation systems;
- Encourage collaborations and new alliances between and among federal, state and local governments and industry in the pursuit of broader participation in support of United States' aeronautics and space sectors; and
- Examine changing relationships between the public and private sectors of the aerospace industry to determine how the states can optimize the value of high technology industry as a basis for economic development.

ASA's delegates give strong voice to the states' unique interests in federal aerospace policy formulation and implementation. Because ASA represents the executive branch of its member states, it focuses primarily on education and economic development initiatives, traditionally the purview of state government.

Education Committee Overview

The Education Committee supports and develops educational initiatives that are in line with national standards and uses aerospace as an integrator and motivator for teaching in pre-K through college. Its mission is to explore and propose new education projects and support existing ones that can be developed to provide benefit to ASA member states in an effort to strengthen American mathematics, science and technology education and national standards.

Education

Educational excellence is a unifying theme of ASA member states. States have primary responsibility for the education of students, the work force and the general public. Building and maintaining the educational infrastructure, developing curriculum that transfers knowledge from generation to generation and stimulating the pursuit of new knowledge is the purview of the states.

ASA believes that public participation in aerospace is crucial to public support for aerospace. Education is the quickest and surest means of demonstrating a return on the public's investment in aerospace programs. ASA views education as a process, not a product, that should last a lifetime and should reach the broadest possible constituency.

ASA views education in its broadest possible sense, to include, but not be limited to, education of the citizenry through a process of life-long learning, including pre-K, K-12, undergraduate, graduate and post-graduate education as well as teacher outreach, education to the general public, and education pertaining to policy formulation, analysis, and dissemination to interested parties, at both the state and national levels.

ASA member states are committed to enhancing educational opportunities at the state and local level through the use of aerospace education resources in K-12 classrooms, through advocacy for sufficient funding for college and university research in aerospace sciences and engineering, and by the dissemination of aerospace information to the general public. ASA is committed to developing and implementing state-based aerospace educational programs that serve as a motivating framework for teaching math, science, and technology skills. These learning experiences will prepare our students for vital careers in the high technology workforce of the 21st Century.

Education Committee Members

Dr. Stephanie Wright, Chair – DE
Dr. William Hiscock – MT
Dr. Barry Butler – IA
Sandra Bast – IL

The Aerospace States Association NEWS

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For Immediate Release Contact: Charles Huettner 202 257-4872

Lieutenant Governors To Hold Hearing on NASA Budget, K-12 Education

The Aerospace States Association (ASA) will hold a hearing on February 8, 2006 at 1:00 pm in Room 2325 of the Rayburn House Office Building to review the President's budget for NASA and to raise the visibility of the importance of K-12 science, technology, engineering and math (STEM) education.

ASA's Chairman, Alaska Lieutenant Governor Loren Leman says, "K-12 students need to have an understanding of mathematical and scientific principles and technological processes. ASA wants to bring attention to successful programs and implementation strategies that have a broad impact and national reach in an effort to strengthen and enhance STEM education in the United States."

The hearing will begin with a review of the NASA budget request to Congress and will then be split into two parts: Part I: Program Designers; and Part II: Program Implementers. Testimony will be heard from:

Program Designers:

Ms. Angela Phillips Diaz, Assistant Administrator (Acting), Office of Education, NASA
Dr. Ann Carlson, Senior Staff Associate for Policy & Planning, National Science Foundation
Dr. Henry Johnson, Assistant Secretary, Elementary and Secondary Education, Department of Education

Program Implementers:

Dr. Gerald Wheeler, Executive Director, National Science Teachers Association
Dr. Cathy Seeley, President, National Council of Teachers of Mathematics
Dr. Kendall N. Starkweather, Executive Director, International Technology Education Association

ASA is a bi-partisan organization representative of the grass roots of American Aerospace. It is a scientific and educational organization of Lieutenant Governors and Governor-appointed delegates. ASA was formed to promote a state-based perspective in federal aerospace policy development and to support state aerospace initiatives that enhance student/teacher education outreach and economic development opportunities. Currently chaired by Loren Leman, Lieutenant Governor of Alaska, ASA maintains direct ties to the executive branch of state government.

--End—

The Aerospace States Association

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Meeting Agenda
February 8-9, 2006

February 8 – NASA Budget & STEM Education

Location: Rayburn House Office Building Room 2325, Washington, DC

1:00 p.m.	**Introduction** **Keynote Address**	**Lieutenant Governor Loren Leman** **NASA Associate Administrator, Rex Geveden**
1:20 p.m.	**Program Designers** **Ms. Angela Phillips Diaz, Assistant Administrator (Acting), Office of Education, NASA**	
1:40 p.m.	**Dr. Ann Carlson, Senior Staff Associate for Policy & Planning, National Science Foundation**	
2:00 p.m.	**Dr. Henry Johnson, Assistant Secretary, Elementary and Secondary Education, Department of Education**	
2:20 p.m.	**Program Implementers** **Dr. Gerald Wheeler, Executive Director, National Science Teachers Association**	
2:40 p.m.	**Dr. Cathy Seeley, President, National Council of Teachers of Mathematics**	
3:00 p.m.	**Dr. Kendall N. Starkweather, Executive Director, International Technology Education Association**	
3:20 p.m.	**Discussion**	
4:00 p.m.	**Closing Remarks**	**Lieutenant Governor Loren Leman & all**

Presenter	Remarks	Biography
Rex Geveden	A-1	B-1
Angela Phillips Diaz	A-8	B-3
Ann B. Carlson	A-13	B-5
Henry Johnson	A-18	B-6
Gerald Wheeler	A-20	B-7
Cathy L. Seeley	A-25	B-8
Kendall Starkweather	A-31	B-9

Remarks to Aerospace States Association
Rex Geveden
Associate Administrator
National Aeronautics and Space Administration

8 February 2006

Thank you Chairman Leman (Alaska Lt. Gov. Loren Leman, Chairman Aerospace States Association) for that wonderful welcome and good afternoon ladies and gentlemen. I am delighted to be here today to discuss NASA's ongoing activities in the context of what promises to be a very important year for our nation's space and aeronautics activities.

From Alaska to Florida and from Vermont to California there is a lot of excitement throughout the land about what NASA and the emerging commercial sector are doing to expand our exploration horizons. In the past year, for example, NASA returned the space shuttle to flight, and if all goes well, we will have three shuttle missions to the International Space Station this year. Also, we witnessed the amazing discoveries of the Cassini-Huygens mission to Saturn and its mysterious moon Titan, marveled at the continued journeys of the twin Mars Exploration Rovers, launched the first robotic emissary to Pluto, and returned precious material from a comet with a successful landing of the Stardust mission in Utah. In addition, scientists have discovered what appears to be a rocky Earth-like planet orbiting a distant star, adding to the extrasolar planet count of 160 and growing. No doubt, that planet's equivalent of the Aerospace States Association is convening at this time to discuss having a joint meeting with your organization, for the ultimate junket of all time!

Of course before such a meeting can come to pass, we have a lot of work to do to implement the Vision for Space Exploration. I would like to give you a brief overview of where we are as an agency going into the third year of the Vision. Two years ago, President Bush came to NASA Headquarters to announce a new strategic direction for the space program. He gave NASA the charge to "build new ships to carry man forward into the universe, to gain a new foothold on the moon, and to prepare for new journeys to worlds beyond our own." Today, we are well engaged in productive work to advance the

goals of the Vision, including the resumption of shuttle flights to the International Space Station, and the development of a new generation of spacecraft, space launch and cargo vehicles.

Two days ago the White House released the proposed Fiscal Year 2007 budget for NASA. We're gratified the budget contains a healthy 3.2 percent increase in funding over Fiscal Year 2006 that will allow the agency to replace the shuttle as soon as possible with our new Crew Exploration Vehicle, and to pursue those activities which will enable the resumed exploration of the moon within 12 years. This is especially remarkable that given our nation faces many current pressing issues there our leadership recognizes that we can address these issues without eating our seed corn.

Indeed, in his State of the Union Address the President gave an important focus to the contributions of science and technology to American competitiveness. The President's emphasis on this important national priority is quite gratifying as I believe that leadership in space is a key competitiveness driver through all that our space exploration program does to advance technological innovation, scientific progress and inspire the brightest among our youth to pursue careers in science and engineering. We know history that our nation succeeds best in the technological and economic arena when we take on the hard challenges, of which space exploration is definitely one of the most challenging.

In the days and months ahead, when we discuss the NASA budget and the agency's activities before committees of Congress and other audiences, we will certainly stress the point that NASA is one of the greatest contributors to American leadership in those categories of national greatness that matter the most. And your presence here today, demonstrates the relevance of this subject throughout the country.

Budgets are important. They demonstrate in the case of NASA, President Bush's strong commitment to provide us with the resources we need to successfully implement the Vision and to conduct our other important activities in science, aeronautics and education, a subject Angela Diaz will discuss later in more detail.

This budget submittal builds upon two successive years of bipartisan endorsement in Congress of Vision's goals. As you all well know, it is very difficult these days to get bi-partisan agreement on any subject. So this record is very impressive, and your

organization deserves a great deal of credit for your active role in supporting the Vision, including the resolution you developed soon after the Vision was announced, and all the good work you have done here in Washington and back in the states on behalf of this exploration agenda. We are very grateful for what you've done.

The guiding philosophies and priorities for this budget request are consistent with the President's January 14, 2004 announcement of the Vision, and decisions made by NASA last year on moving forward with a new space exploration architecture, that will among other things give us four times the lunar exploration capability of the Apollo program at 55 percent of the cost.

Among key budget priorities being funded will be the remaining shuttle missions in support of space station assembly, with the shuttle retiring in 2010, and developmental funding to allow for as seamless a transition as possible to our new Crew Exploration Vehicle, as close as possible to 2010, but not later than 2014. This will allow NASA to effectively build on our nation's investment in shuttle facilities and equipment, and most importantly in the outstanding technical people who make our space achievements possible. It is of strategic importance to our country that as a matter of national leadership in the world we maintain the ability to send humans into space, and not be dependent on other nations' space faring capabilities.

The proposed budget also funds an important NASA initiative to help spur the development of a viable commercial space industry. Last month, NASA issued a challenge to U.S. industry, both the established aerospace companies and the emerging entrepreneurial companies. Through our Commercial Orbital Transportations Services Demonstrations announcement or COTS, we are challenging all interested parties to demonstrate through competitive proposals that they can establish capabilities and services to safely and reliably support the space station's crew and cargo transportation needs.

This initiative establishes a precedent. For the first time ever, NASA is seeking non-government vehicles and commercial services to provide these capabilities for human space flight. When this happens, hopefully by the end of the decade, our colleagues with the Federal Aviation Administration will have a role in helping to determine safety requirements for the commercial providers' launch vehicle.

For what we hope will result in a Space Act agreement or agreements, we are putting up a about a half-billion over the five years of our current budget run out for those companies that have the best proposal for Earth-to-orbit space flight demonstrations of any one or combination of four capabilities: first, external un-pressurized cargo delivery and disposal; second, internal pressurized cargo delivery and disposal; third, internal cargo delivery and return, and fourth, crew transportation. The International Space Station provides the representative requirements for these capabilities, as with the retirement of the space shuttle scheduled in 2010 we will need a means other than the Crew Exploration Vehicle now in development and reliance on other nation's capabilities to support the station's operation through 2016.

Phase One proposals for the COTS demonstrations are due in March, and we expect to announce and award one or more Space Act agreements this summer. We hope that successful flight demonstrations of the selected capability will occur in the 2008-2010 timeframe. During the first phase of this technology demonstration initiative, NASA intends to provide capital and assistance similar to an investor to help provide the necessary stimulation to ensure the success of this venture. The second phase of the technology demonstration initiative is the possible purchase by NASA of commercial transportation services to and from the space station on a purely commercial basis relationship with the transportation suppliers. What this initiative means to you is that as we open up more opportunities to emerging entrepreneurial companies, as well as to the traditional aerospace companies, we can fully expect to see more business entities and states involved in NASA's program than in the past.

Returning to the budget request, I must caution that it also reflects the fact that given today's fiscal realities, especially for domestic discretionary spending, NASA cannot do everything that was on the agency's plate when Administrator Griffin arrived in April last year. The budget is a sound one that reflects the President's and Congress's priorities for NASA within the resources we expect to receive for the foreseeable future—roughly 0.7 percent of the federal budget. The budget emphasizes making steady progress on upcoming major program milestones and work to be done to develop that next generation of NASA space craft, launch vehicles and systems. And to be certain, it emphasizes the sense of urgency we have in making sure in that we continue the

momentum we have in executing a decades-long plan for space exploration and scientific discovery.

Under this budget, NASA will maintain a robust science program, continuing to grow each year within the budgetary constraints that face the entire federal government, until our transition from the shuttle is complete. This budget will support progress in NASA's Earth observations, planetary exploration, solar and astronomy programs. We are the world's leader in all these activities, and do not intend to forfeit this leadership, which is integral to our aims with the Vision.

Similarly, the budget picture with respect to NASA's aeronautics program does not tell the whole story. While we are restructuring investments in aeronautics, as previously planned, we are doing so with a new strategy to maintain and enhance competencies important to the nation. One of our goals is to re-establish NASA's dedication to mastery of the core competencies of aeronautics research in subsonic, supersonic, and hypersonic flight. We will also attempt to focus our aeronautics research dollars on areas that are appropriate to NASA's unique capabilities, and leverage our work with other federal partners such as the Department of Defense and Federal Aviation Administration. In this regard we are also working closely with the Defense Department to ensure that we take a national asset approach to our wind tunnels.

With the budget we will make strategic investments in our people and facilities to preserve and strengthen our most important assets. This budget will enable us to provide our engineers, scientists, astronauts and supporting staff at our 10 Centers throughout the country with an environment that will help them succeed, by giving them the best possible facilities, infrastructure and training.

I would like to add a cautionary note about the budget process as we go forward. We hope that the era of excessive earmarks is coming to an end. In our current budget, there are 198 congressional interest items, valued at over $560 million, an increase of more than $100 million over the previous year. While individual earmarked items may be meritorious, when you sum them up the growth of these unrequested Congressional directions erodes NASA's ability to carry out its mission of space exploration and peer-reviewed scientific discovery. Also, the redirection of funding to support Congressional direction has resulted in measurable impacts upon NASA's ongoing science and

education programs, including delays and/or cancellation of planned activities. So we do hope that there will be more discipline exercised as the legislative process proceeds this year.

Also looking forward, we do intend to recruit the best and brightest engineers out of college to help us develop the next generation spacecraft, launch vehicles and systems that will enable NASA's voyages of exploration to unfold. These exciting missions will motivate today's grade school and high school students to want to work as engineers and scientists in the space program.

Nothing is more important to our future in space. As our former Chief Engineer I am acutely aware that the engineers of the Apollo era – which ended over thirty years ago – have nearly disappeared at NASA. Our present generation of engineers has largely cut their teeth on the Space Shuttle and Space Station programs. And even this "baby-boomer" generation of engineers will eventually pass from the scene. So we will need the talented young engineers and the promising students coming up through the educational pipeline, because the era we are entering must have a steady flow of engineering talent for the next thirty years, and beyond.

While NASA is not the Department of Education, consistent with our charter we do spend nearly $167 million on education initiatives that are targeted to our future workforce needs and to developing the talent, skills and professions necessary to carry out the Vision for Space Exploration. We also spend a like amount in the context of education and public outreach efforts associated with individual space missions. We must ensure that these investments benefit not only NASA, but also the aerospace industry as a whole.

To be certain, what we and you do in this regard has broader implications. As the blue-ribbon panel of the National Academy of Sciences headed by Norm Augustine has so forcefully pointed out, there has been a steady erosion in investment in the kind of scientific and engineering brainpower that keeps a nation competitive—and a consequent decline in American inventiveness. So anything that we can do to arrest these trends—to inspire young students to pursue technical careers, and to motivate talented foreign-born graduate students to consider staying in the United States and work on the greatest exploration project of the 21st century—would be all to the good.

So, this in essence is where we stand as we enter a very promising year for exploration and discovery. I thank you for your hospitality today, and again extend my heartfelt thanks to all of you for your commitment making American leadership in space and aeronautics truly an enterprise that involves all of our citizens in all of our states.

HOLD FOR RELEASE
UNTIL PRESENTED
BY WITNESS
FEBRUARY 8, 2006

Statement of

Angela Phillips Diaz

Assistant Administrator (Acting)
For Education

National Aeronautics and Space Administration

Before the Aerospace States Association

Rayburn House Building

Washington, DC

February 8, 2006

Lieutenant Governor Leman and Members of the Aerospace States Association, thank you for the opportunity to appear today at this hearing to discuss science, technology, engineering, and mathematics (STEM) education at NASA.

For nearly 50 years, NASA's journeys into air and space have deepened humankind's understanding of the universe, advanced technology breakthroughs, enhanced air travel safety and security, and expanded the frontiers of scientific research. These accomplishments share a common genesis: Education.

The Aerospace States Association has demonstrated its interest in enhancing education outreach, economic development opportunities, and global competitiveness. We appreciate the initiatives and partnerships between NASA, member states and their aerospace industries. We also value and enjoy working with other formal and informal partners in STEM programs and activities.

It is important that NASA, associations such as the Aerospace States Association, and other stakeholders (federal, corporate, legislative, academic, private, and public) work together to strengthen the nation's future science and technology workforce. The nation has a tremendous need for a skilled workforce and NASA is taking a leading role to inspire interest in science, technology, engineering, and mathematics, as few other organizations can, through its unique mission, workforce, and facilities. The agency is also taking a leading role to make significant impacts in engaging underserved and underrepresented communities in STEM.

It is important that we work together to strengthen and expand the K-16 STEM pipeline. Over the years, NASA's achievements have inspired countless individuals from all walks of life. The information age has made our task easier in some ways, but more difficult in others. Today there is increased competition for the minds and imaginations of young people. It has become increasingly difficult to interest students in science, technology, engineering, and mathematics. Therefore, we must work together to engage students in our education programs in these areas as early as possible.

NASA engages students in K-16 STEM by reaching out to Americans through NASA's mission. By using hands-on, interactive educational activities, NASA engages students, educators, families and the general public in the Vision for Space Exploration, which will return humans to the moon and journey to Mars and beyond, as well as in science and aeronautics research, thus increasing science and technology literacy to the benefit of the nation as a whole.

Education is a fundamental element of NASA's activities reflecting a balanced and diverse portfolio of: Elementary and Secondary Education, Higher Education, Minority University Research and Education Programs, Informal Education, and e-Education Programs.

In May of 2005, the National Academies was asked to respond to the following questions, "What are the top 10 actions, in priority order, that federal policy-makers could take to enhance the science and technology enterprise so that the United States can successfully compete, prosper, and be secure in the global community of the 21st century? What strategy, with several concrete steps, could be used to implement each of those actions?

The Academy assembled a distinguished team, including three Nobel Prize winners, business executives, and university leaders who reported their findings in a report entitled, *Rising Above the Gathering Storm: Energizing and Employing America for a Brighter Economic Future.* The report proposes four broad recommendations: 1) increase America's talent pool by vastly improving K-12 science and mathematics education; 2) sustain and strengthen the Nation's traditional commitment to long-term basic research; 3) make the United States the most attractive setting in which to study and perform research; and 4) ensure that the United States is the premiere place in the world to innovate.

As a result of the report findings, Senators Lamar Alexander (R-TN), Pete Domenici (R-NM), Jeff Bingaman (D-NM) and Barbara Mikulski (D-MD), introduced the Protecting America's Competitive Edge (PACE) Act, which will enable the United States to build on our existing strengths to help secure America's continued economic prosperity in the twenty-first century. Senator Alexander said, "We are now playing in a tougher league. China and India are competing for our jobs. The best way to keep those jobs in America is to maintain our brainpower edge in science and technology."

We, as a nation must be proactive in meeting the challenges before us. The educational activities we will support over the next several years will be designed to inspire, engage, educate, and employ our Nation's talented youth.

Employment of those talented individuals in disciplines needed to achieve NASA's mission and strategic goals is of paramount importance to the agency. Through internships, fellowships, and other professional training, individuals will become participants in the Vision for Space Exploration and NASA science and aeronautics research. NASA can only achieve its mission if new STEM professionals have acquired sufficient mastery of knowledge and are prepared for employment with NASA, academia, industry, or within STEM fields of teaching.

The Aerospace States Association has indicated a specific interest in raising the visibility of the importance of K-12 STEM education. In that regard, I will address some of the activities of our Elementary and Secondary Education Programs.

NASA believes that increasing the number of students involved in NASA-related activities at the elementary and secondary education levels will inspire more students to pursue higher levels of study in science, technology, engineering, and mathematics courses. The Elementary and Secondary Education Programs engage students, educators, families, and institutions through programs to increase the rigor of STEM experiences provided to K-12 students through workshops, internships, and activities; provide high quality professional development to teachers in STEM topics through NASA programs; develop technological avenues through the NASA website that will allow families to learn about space exploration; encourage inquiry teaching in K-12 classrooms; improve the content and focus of grade level/science team meetings in NASA Explorer Schools; and share knowledge gained through the Educator Astronaut Program with teachers, students and families. The Educator Astronaut Program provides opportunities to the education community to discuss topics applicable to classroom studies with astronauts on the International Space Station (ISS). Classrooms also have the unique capability to integrate images taken via the internet from a camera on the ISS into their earth science studies.

Our **NASA Explorer Schools Program** offers a three-year partnership between NASA and school teams, consisting of teachers and education administrators from diverse communities across the country. Focusing on underserved populations, the program is designed for education communities at the 4-9 grade levels to help middle schools improve teaching and learning in STEM education through significant structural (professional development, stipends, grants) and curricular supports based on NASA's resources.

One hundred fifty NASA Explorer School (NES) teams represent 50 states, District of Columbia and Puerto Rico:

- 87% represent high poverty populations
- 76% represent high minority populations

- 26% have >50% African American students
- 21% have >50% Hispanic students
- 5% have >50% Native American students
- 24% have >50% multiple minority groups

A specific example is Lieutenant Governor Leman's state of Alaska, which has five NASA Explorer Schools. Two are in the Kenai Peninsula Borough School District (Nikiski North Star Elementary in Nikiski, AK; and Sterling Elementary in Sterling, AK). Three are in the Chugach School District (Chenega Bay Community School in Chenega Bay, AK; Whittier Community School in Whittier, AK; and Tatitlek Community School in Tatitlek, AK).

Over the three-year partnership, Explorer School teams work with NASA personnel and other education partners to develop and implement strategic plans for staff and students that promote and support the use of NASA content and programs to address the teams' local needs in mathematics, science, and technology education. In-service opportunities are provided in the summer and during the school year in collaboration with NASA centers, professional education partners, state science and mathematics coalitions and space grant consortia.

Educators and students are provided with content specific activities that can be used in many local and state curricula, which support the active engagement of students in science, technology, and mathematics investigations to increase their ability to apply to these disciplines and learn about career paths. Schools in the program are eligible to receive up to $17,500 over the three-year period to support the purchase and integration of technology tools that support student engagement in science and mathematics.

The **NASA Digital Learning Network (DLN)** provides people, technology, facilities, programs, and resources to deliver learning opportunities via videoconferences to teachers and students. The formation of learning communities through digital networks is key to the dissemination of NES professional development, collaboration of participants and the interaction of widely dispersed and sometimes remote NES schools with NASA experts. The DLN is supported by NES at each NASA center and is expanding to include additional education partners. Each NES school is required to develop the capability to connect to the DLN system.

Partnerships for sustainability –supports the formation and operation of partnerships between NASA Explorer Schools and state coalitions of business, state government and education to build a sustainable role for NES in the state-based efforts to improve science, technology, and mathematics education for all students and sustain them beyond the three-year funding period.

Conclusion

The NASA Office of Education is committed to three primary objectives to help improve the state of STEM education in our country:

1. Strengthen NASA and the Nation's future workforce – NASA will identify and develop the critical skills and capabilities needed to ensure achievement of the Vision for Space Exploration, science, and aeronautics.

2. Attract and retain students in STEM disciplines through a progression of educational opportunities for students, teachers, and faculty - to compete effectively for the minds, imaginations, and career ambitions of America's young people, NASA will focus on engaging and retaining students in STEM education programs to encourage their pursuit of educational disciplines critical to NASA's future engineering, scientific, and technical missions.

3. Engage Americans in NASA's mission – NASA will build strategic partnerships and linkages between STEM formal and informal education providers. Through hands-on, interactive, educational activities, NASA will engage students, educators, families, the general public, and all agency stakeholders to increase America's science and technology literacy.

We are preparing the pathway for the next generation with great anticipation. These "explorers and innovators of the new millennium" must fully represent our Nation's vibrant and rich diversity. Furthermore, we will support our Nation's universities, colleges and community colleges by providing exciting research and internship opportunities that "light the fire" and "fuel the passion" for a new culture of learning and achievement in science, technology, engineering, and mathematics.

Our children's educational achievement is not merely a federal issue, but one that reaches our nation at the most local level. As NASA continues to partner with state and local communities and invest our resources into a shared vision, we must also work together to ensure that our students reach their full potential to secure those jobs in the 21st century workforce that are indeed a product of that investment. The President, Administrator Griffin and all of NASA share the belief that our Vision can only be a success with a strong relationship between the federal mission and our local counterparts to accomplish these goals.

NSF STRATEGIES TO STRENGTHEN
AND ENHANCE K-12 STEM EDUCATION
Dr. Ann B. Carlson
Senior Staff Associate for Policy and Planning
National Science Foundation
Aerospace States Association
Rayburn Building
Room 2325
February 8, 2006

If we are to strengthen and enhance our nation's science, technology, engineering and mathematics education – what we refer to as STEM education – it is critically important to bring together program designers with program implementers, as you have planned, for substantive discussion. I am confident today's hearing will benefit us all.

The President underscored the significance of STEM education in his State of the Union Address, and has followed up with a definite plan of action. His *American Competitiveness Initiative* commits nearly $6 billion in FY2007 to increase investments in research and development, strengthen education, and encourage entrepreneurship. The agencies represented here all share a commitment to these aims, and I want to note that we have a long and productive history of working together to maximize the impact of our education investments.

At the National Science Foundation, we have a mandate to support fundamental, frontier research and education across all non-medical scientific and engineering fields. As our Director, Arden Bement, has said on numerous occasions: "NSF's greatest contribution to the nation's innovation systems is the direct transfer of new scientific and engineering concepts from research laboratories to the entrepreneurial sector via the STEM-educated talent pool."

This necessity of having a STEM-educated talent pool is also the reason NSF is the principal federal agency charged with promoting and improving science and engineering education. And I should point out that "bolstering K-12 education" is one of four priority areas in NSF's FY2007 budget request. We have over 48 programs designed to develop evidence-based education strategies through research on STEM learning, teaching, and evaluation methods, and to improve four things:

- formal and informal STEM instructional materials and methods,
- teacher preparation and professional development,
- student performance and interest, and
- the recruitment to and retention of students in STEM interest, STEM majors, and STEM graduate programs and careers.

In addition, we are committed – across the foundation – to the integration of research with education; involving K-12 students, teachers, and undergraduate students in NSF-

sponsored research, as well as graduate students and postdoctoral researchers. As we regularly remind ourselves, the integration of education with research "infuses education with the excitement of discovery and enriches research through a diversity of learning perspectives."

You asked for an overview of the Foundation's education strategy. In addition to the broad strategy I've just outlined, there is one component that I want particularly to emphasize to this audience – because we need your participation, and that of all our partners, to carry it out: *We want to do nothing less than completely change national thinking about the study of science, technology, engineering, and mathematics.*

When we were young, many of us were advised that a degree in literature, history, or philosophy would teach us to think and prepare us to serve in any number of careers. Law degrees today seem to be the degree of choice for any number of career pursuits. But, how many people are advised to study biology, mathematics, or civil engineering simply because it will teach you to think, to question, to solve problems, and to thrive in an increasingly technical society? How many are told that these degrees will prepare you for any number of potential careers?

I owe my own decision to study science to the National Science Foundation. Until I took an NSF-sponsored summer physics and astronomy program, I planned to follow my sister and my grandmother into the study of English literature. The summer research experience completely changed my mind and I went on to major in physics, ultimately earning a PhD in Aerospace Engineering. I worked directly in that field for only 4 years, but my science and engineering training were excellent preparation for every aspect of my career to date. I am delighted to have come full circle and now work in designing NSF's programs and policies.

The *American Competitiveness Initiative* recognizes the national need not just for STEM professionals but for "a scientifically, technically, and numerically literate population." We've come a long ways from the days when too much "book learning" was viewed with general suspicion, but too many in this country still have misgivings about the study of mathematics and science. Science, Technology, Engineering, and Mathematics are not just for nerds! Our NSF education agenda is to see STEM studies and the STEM degree take their place – in the minds of all America – as essential education that opens multiple career options and prepares the student for life.

Your invitation also asked that we outline some example programs that illustrate how we are implementing our education strategy. I would like to elaborate on three of our many programs.

Noyce Scholarship Program

The Robert Noyce Scholarship Program, initiated in 2002, encourages talented STEM undergraduate students and postgraduate professionals to become elementary and secondary mathematics and science teachers. The program offers grants to institutions that then provide scholarships to juniors and seniors majoring in STEM disciplines, or

stipends for science, mathematics, or engineering professionals in the workforce seeking to become teachers.

Recipients of Noyce scholarships or stipends commit to teaching two years in a high-needs school district for each year of support they receive. The current portfolio consists of 57 grants to a variety of institutions and is producing approximately 2,500 new science and mathematics teachers for high-needs school districts across the country.

The Drexel University Noyce Scholarship Program (DUNS) is an excellent example of what this program can accomplish. With support from the Noyce Scholarship Program, Drexel University is recruiting science, engineering, and mathematics majors who are committed to teaching mathematics and science in the School District of Philadelphia. Recruitment efforts are focused on the Community College of Philadelphia, the Philadelphia Alliance for Minority Participation, and the Center for Civic Engagement at Drexel University.

The first cohort of 15 recipients, 43% of whom are minority students, includes nine undergraduate chemistry majors and six STEM professionals ("career-changers"). The program provides strong teacher preparation, addressing content knowledge, pedagogical knowledge, learner knowledge and technology integration. Mentoring and training activities provide support to the new teachers.

To broaden the exposure of students to teaching, the DUNS Noyce Seminar Series provides a venue for Noyce Scholars to interact with teachers, scientists, and experts who are leaders in pedagogy, science and mathematics teaching, or scientists with a penchant for teaching. The seminar series has addressed topics such as *Promoting Girls' Inclusion in Mathematics and Science*; *Teaching Math and Science in Philadelphia*; and *Physics on Fifth Avenue*. Noyce Scholars report that their experience in the program has contributed to an increased understanding of the use of technology in the classroom and an increased ability to identify problems and implement action/solutions in teaching situations.

Drexel University Noyce Scholarship Program

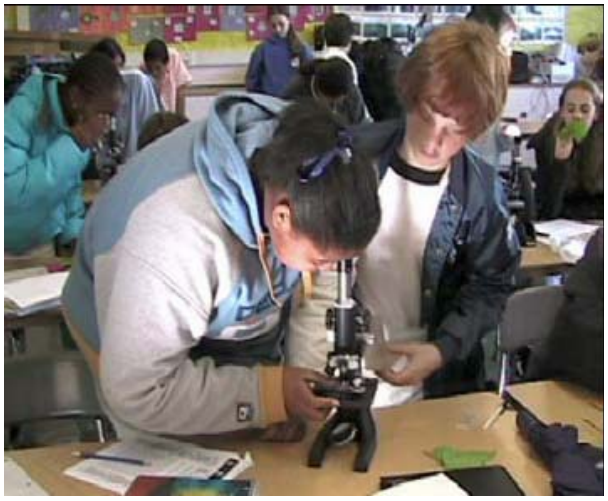
Information Technology
Experiences for Students and Teachers (ITEST) Program

The Information Technology Experiences for Students and Teachers (ITEST) Program provides opportunities for students and teachers in grades 7-12 to learn about, experience, and use information technology (IT) in the context of STEM education. In 2005 ITEST, which is funded by H1-B Visa fees, reached approximately 18,800 students and 1,600 teachers across the nation.

The goals of the program are (1) to provide students with engaging STEM educational opportunities, including research experiences, beyond that offered in traditional classrooms, and (2) to deliver professional development for teachers on IT skills that bring new content and IT enhanced instructional practices to their classrooms.

ITEST fosters collaboration among higher education, museums, science centers, industry and middle and secondary schools.

With support from ITEST, the Center for Embedded Networked Sensing Education (CENSei) at the University of California-Los Angeles is demonstrating to students and teachers the capabilities of cyberinfrastructure. CENSei's web-supported curricular materials allow middle school students to explore scientific data collected from embedded sensors deployed in Southern California ecosystems. CENSei draws on the expertise of education researchers, natural scientists, information scientists, and teachers to overcome the challenges students face in understanding and working in scientifically rich, data-intensive environments. They are discovering how use of an appropriate interface combined with support for student inquiry can engage students and promote learning. CENSei capitalizes on NSF's investment in the Center for Embedded Network Sensing, one of our Science and Technology Centers.



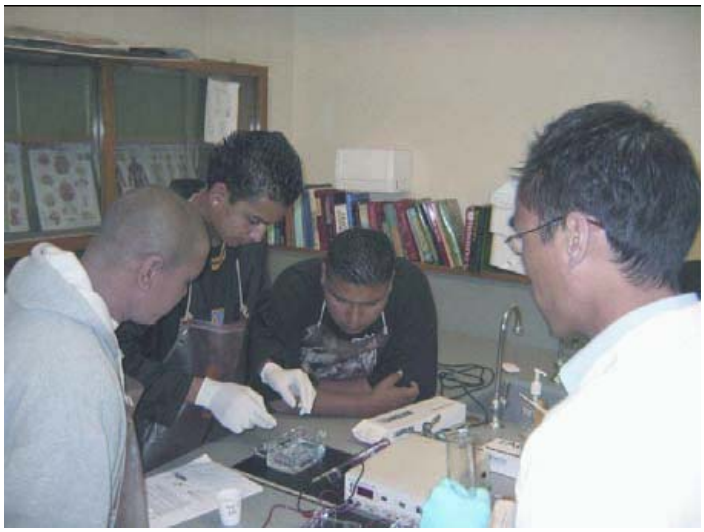
Students at the Center for Embedded Networked Sensing Education (CENSei) at the University of California-Los Angeles.

Another example of the impact of the ITEST program is the Southeast University and College Coalition for Engineering Education, or SUCCEED, Apprenticeship Program that provides entering 9th grade students in Durham, NC with intensive, multi-year experiences in computational science. Research teams of ten apprentices and one mentor meet weekly during the school year and over eight weeks in the summer. Students contribute to four hands-on projects: the National Digital Science Library (metadata tagging and web design), SUCCEED (website design and web applications), Digital

Durham (postcard database), and Sigma Xi (web support). These experiences enrich the students' education and give them hands-on experience in information technology.

Graduate Teaching Fellowships in K-12 Education
Finally, the NSF Graduate Teaching Fellowships in K-12 Education Program, or GK-12, was initiated in FY 1999 and supports fellowships and associated training to enable graduate students in NSF-supported STEM disciplines to acquire additional skills that will prepare them for professional and scientific careers in the 21st century. Through interactions with teachers in K-12 schools, graduate students improve communication and teaching skills while enriching the school's STEM instruction. Fellows also serve as role models for the K-12 students. I particularly like this program because I believe that participating in K-12 education early in their research careers instills GK-12 fellows with a commitment to the integration of research with education at all levels, a perspective that we believe will last a lifetime. The FY2007 budget requests an increase of almost 10% for the GK-12 program, a level that will support an estimated 1000 graduate fellows.

An excellent example of the impact of GK-12 on fellows and on K-12 students can be found in the "UCLA STEM Graduate Fellows in Los Angeles Urban Schools" project. The UCLA fellows, all from STEM disciplines, participate in designing and testing curricular materials and collaborate with K-12 teachers to help K-12 students gain an enriched understanding of mathematics and science. Fellows also serve as role models for careers in science and mathematics and gain experience engaging professionally with a diverse audience. The UCLA program impacts over 135 first-year mathematics and science teachers and over 50,000 students in poorly performing Los Angeles schools. Fellows are adapting, developing, and field-testing more than 200 standards-aligned, inquiry-based mathematics and science activities. This resource of edited materials with annotated teaching notes is published and distributed electronically through the "UCLA in LA" web site (http://www.la.ucla.edu), a portal created by the University, useful to a national audience.



Dean Won, UCLA GK-12 Fellow

Aerospace States Association
Dr. Henry Johnson
Assistant Secretary
Elementary and Secondary Education
Department of Education

February 8, 2006
Rayburn Building

Talking Points:

- The Aerospace States Association (ASA) is to be commended for recognizing that improving the education of students in elementary and secondary schools is essential to the wellbeing of your industry and to the nation as a whole.

- The U.S. Department of Education is committed to improving mathematics and science education, and is pleased to join ASA and the many other organizations and groups throughout the nation who are calling for more and better mathematics and science learning in our schools.

- While the research base in mathematics and science learning is not as strong as we would like it to be, there are several things that we do know:

  --Teachers can't teach what they don't understand. Yet just over half of the middle school math teachers in this country have neither a major nor a minor in mathematics. These teachers work with 65 percent of our nation's children. We also know that the vast majority of elementary school teachers have only had a course or two in mathematics or mathematics methods courses. About a quarter of high school math teachers do not have a math major or minor in the subject.

  --Students can't learn what they haven't been taught. We know that many students receive very little mathematics instruction, and what is offered is typically at quite a low level. Children in high poverty schools are particularly vulnerable, and often receive a very thin curriculum.

  --Students can't do well on challenging assessments if they haven't had the opportunity to apply their mathematics learning to rich and complex problems. Many students are not given the skills or opportunity to understand how to use mathematics that will allow them to perform well on demanding assessments.

- I've been asked to describe several programs in our portfolio that address these issues.

  --The Mathematics and Science Partnerships program, Title II, Part B, of NCLB provides funds to the states so that they can make competitive awards to projects that support content-based professional development

for teachers. The partnerships must be between mathematics, science and engineering university faculty, and high need school districts. The states have made over 500 grants under this program, and most are offering intensive, sustained training in math and science content. In fact, the average number of professional development hours for a participating teachers is 120 plus hours in a year—much more extensive than most professional development. This program addresses the problem of a lack of content knowledge in teachers.
--The Advanced Placement Incentive program is another effort to improve advanced learning in math and science—as well as other subjects. The program helps to support so that more schools can offer more AP and IB classes, and to offset the costs so that more students can afford to participate. In fact, we hope to expand this program dramatically if our request in the 2007 budget is successful.

- As I'm sure you have heard, the President just announced in the State of the Union address a breathtaking and comprehensive plan for mathematics and science: the American Competitiveness Initiative. The President is proposing an array of programs to support K-12 education:

  --A National Mathematics Panel of experts to identify instructional methods and materials from research.
  --Math Now for Elementary School Students that promote promising research-based practices that prepare students for algebra by the end of 7th grade.
  --Math Now for Middle School Students will work with struggling students to prepare them to be successful with algebra.
  --AP-IB Incentive program will train an additional 70,000 teachers to lead AP-IB math and science courses.
  --Adjunct Teacher Corps: will add 30,000 qualified math and science professionals to become adjunct high school teachers by 2015.
  --Evaluating the effectiveness of Federal investments in STEM programs. Include Science Assessments in NCLB.

We look forward to working with you on this important work.
Thank you for the opportunity to participate in this important dialog. I am prepared to take any questions.

Dr. Gerald Wheeler
Executive Director
National Science Teachers Association
STEM Education
February 8, 2006

Thank you for the opportunity to provide testimony to you today. My name is Gerry Wheeler, and I have been involved in science education for the last 40 years. For the last 10 years I have served as Executive Director of the National Science Teachers Association.

NSTA is the largest organization of science educators in the world. Our membership consists of tens of thousands of science educators, administrators, college professors, curriculum developers, and others with an interest in quality science education.

As the leader in science education, NSTA provides a number of products, services, and programs to the education community, primarily to teachers of science. We offer a number of quality professional development conferences each year, where more than 30,000 teachers come for face-to-face learning opportunities and to view the largest exhibit of science teaching materials and services.

Last year NSTA Press and Publications sold more than 135,000 publications and computer based products, and we offer a wide range of professional development journals that provide more than 100,000 teachers at all levels with proven classroom instructional techniques.

Eleven publishers now feature NSTA-vetted Internet sites—known as SciLinks—in textbooks that are used by more than 104,000 teachers and 470,000 students.

NSTA Express, our weekly e-newsletter, reaches almost a quarter of a million readers. Building a Presence for Science, which for ten years has brought standards based materials and information to schools nationwide, now has over 30,000 educators in 26 states.

We offer a host of online learning opportunities such as web seminars and symposium with NASA and other federal agencies and providers. Later this spring we will release a system of content focused online training on individual science subjects such as energy and light and motion, through our Science Objects and SciPacks initiative. We are also launching a new e-Portal system where teachers can assess their content strengths and weaknesses, then be able to plan, implement, and track their personalized professional

development plan right from their home or school using NSTA and NSTA approved resources.

NSTA also works with a number of federal agencies including NASA, the National Science Foundation, NOAA, the FDA, and the Department of Education on a host of programs for teachers. Our largest programs are the NASA Explorer Schools, which provide quality standards based science content and training to targeted low performing schools, and a national e-Mentoring program for new science teachers that is made possible through a NSF Math and Science Partnership Grant.

With these programs we believe we are helping to make a difference in the science education we provide to our students. But much more must be done.

The Challenges Ahead

Almost 50 years after the launch of Sputnik—and more than two decades after *A Nation At Risk*--American students are a long way from ranking first in mathematics and science. Many business, science, education, and research leaders realize the need to improve K-12 science and mathematics education has never been greater.

The good news is more students that ever are taking higher-level science classes and the number of students taking AP tests in science has grown rapidly. The bad news is we are not seeing uniform improvements in student achievement and far too many students from disadvantaged populations are lagging far behind their peers.

Student interest in math and science continues to decline. Many students are faced with a lack of challenging courses, while other students, especially minorities, are discouraged from taking such courses.

International tests show some gains for American students at the 8^{th} grade, but scores for 4^{th} grade students have remained flat. Scores for our 12^{th} grade students tend to fall at the bottom of all international rankings.

The number of certified science and math teachers at the middle and high school levels is down, and record number of teachers continue to leave the profession.

In the midst of all this, states and districts must ensure that science is tested once at all three levels under No Child Left Behind, starting in the 2007-08 school year.

These challenges and many more at the K-12 level must be addressed if we are to motivate and prepare students for careers that support our nation’s aerospace vision.

NSTA believes the key ideas listed below that can be adapted and used at the national, state, and local levels are critical to any real reform efforts in science education:

All stakeholders concerned with quality science must be involved with reforms to K-12 science education. These stakeholders include scientists, engineers, business leaders, educators, teachers, administrators, parents, and higher education representatives.

At the national level, we are encouraged by the recent efforts outlined by the National Academies of Sciences report titled Rising Above the Gathering Storm report and the subsequent legislation introduced which seeks to implement the report's recommendations. These recommendations, if enacted properly, will have a positive effect on the way we train future teachers and provide professional development to current teachers.

At the district and school levels, many administrators are simply not placing enough focus on the quality and the amount of science education that is provided to their students. Many elementary schools are reducing the amount of science education their students are receiving or eliminating it altogether because of pressure to show achievement in other subjects.

We risk failing our children by marginalizing the quality of the science education they need and deserve. District administrators, school boards, and others must realize that now is the time to focus on science education programs—not abandon them.

Programs for science education must be scalable. To sustain a world-class science and engineering workforce we must develop more innovations and programs at the proper scale to have a significant impact. We talk about pockets of excellence here and there, but few of these initiatives that help teachers enhance their content knowledge and deliver effective instruction or programs that offer insight into how students learn ever get to a scale that will result in a substantial increase in student achievement across the nation**.**

Programs for science education must be sustainable. Any long-term vision for meaningful reform must include programs that are scalable and sustainable. Far too often the grant funding for programs expires for critical programs that move research into practice, develop new and improved instructional materials and assessments, create better teaching training techniques and explore new uses of technologies to enhance K-12 instruction. The education sector must use strategies from the business community to ensure that working projects remain viable and show greater results over a longer period of time.

Teachers must gain a deeper understanding of the science in their school's curriculum. Knowing how to teach science and understanding how students learn are very important but teachers cannot teach what they don't know.

Teachers need to keep their content knowledge and teaching methods fresh and effective in order to improve student learning. Most teachers attend training programs for only a

few hours a year, far below the minimum of 60 to 80 hours of quality training that research tells us is necessary to bring about meaningful change in teaching behaviors.

Yet when Congress reauthorized No Child Left Behind, they eliminated the Eisenhower professional development grants, which for years had provided dedicated funding for science and math teacher training. This lack of funding has resulted in reports from scores of science administrators and teachers that their districts are reducing or eliminating much needed professional development programs.

We must encourage decision makers in schools to invest in a long-term commitment to professional development. We need to help end the isolation that many classroom teachers feel by providing more time for collaboration among teachers; study groups, and lesson study.

Teacher education for teachers of science must be strengthened.
Pre-service teacher training in science is not valued. A survey of 1,000 deans of education by the Bayer Corporation shows that 76 percent give a high grade to their English preparation program and 56 percent of the deans give a high grade to their math teacher preparation program, but only 40 percent give a high grade to their school's science teaching preparation program.

The same survey of new teachers tells us that 38 percent of new teachers gave their English preparation program an A grade, while only 18 percent gave their science teaching preparation program an "A".

Many teachers, especially elementary teachers, lack content knowledge to effectively impart information to their students. Solving this problem in a scalable way will take the cooperation and innovative ideas from teacher preparation programs, in-service teachers, and other stakeholders in K-12 science education.

Classroom teachers must have the support and resources they need to effectively teach science. We must continue to champion best models and practices in the areas such as curriculum, professional development and teacher quality, assessment and accountability, and research and ensure that these best practices are aligned with the practices in the classroom.

Elementary science education must be improved An NSF-funded study of elementary teachers shows us that 75 percent of the elementary teachers surveyed reported they felt well qualified to teach language arts and reading, and 60 percent said they felt qualified to teach mathematics**, but only about 25 percent of these elementary teachers reported they felt well qualified to teach science.**

We must bring good science, based in investigation and conceptual learning, to all children beginning at the elementary level. Without a high quality elementary science program, we will never develop a truly educated, science literate citizenry.

The understanding of science concepts builds cumulatively. A solid foundation during elementary school gives students a better grasp of science at the secondary level, and beyond. Moreover, experiential science at the elementary level requires students to use math, literacy and reasoning skills in an authentic, applied context.

More middle level and high school teachers of science must be certified.
The Chief State School Officers estimate that only 58 percent of the science teachers in grades 7–8 were certified in science in 2002. Many middle level science teachers are teaching on elementary certifications and will not meet the NCLB definition of highly qualified.

The percentage of subject certified high school teachers is also down. The Chief State School Officers estimate that in 2002, only 83 percent of biology teachers nationwide were certified; 82 percent of chemistry teachers were certified and 75 percent of physics teachers are certified, and 72 percent of earth science teachers were reported certified. All of these figures are down from 10 years ago.

The need for qualified science and math teachers is even more acute in urban areas. A survey of 40 top urban school districts administrators tells us that 98 percent of these districts reported an immediate need for science teachers. These districts teach over 5.5 million students, which is more than 10 percent of the nation's public school enrollment

In closing, we need to remember that working to change and strengthen science education is a complex and challenging task, and there are no easy answers. Recent reports have made it clear that science literacy is key to our nation's economic growth, future workforce, national security, and more. NSTA supports many of these initiatives, but we must remember to include science teachers in any and all efforts to reform K-12 science education. I think that everyone in this room can agree that quality science education that begins with youngest learners and is taught by a qualified teacher with the support of many stakeholders is very important to the aeronautics industry. Thank you and I look forward to any questions you may have.

NATIONAL COUNCIL OF TEACHERS OF MATHEMATICS

TESTIMONY

Aerospace States Association

Hearing on

K-12 Science, Technology, Engineering and Mathematics (STEM) Education

February 8, 2006

2325 Rayburn House Office Building

1:00–4:00 p.m.

Cathy L. Seeley

President

National Council of Teachers of Mathematics

Testimony of Cathy L. Seeley
President, National Council of Mathematics

Thank you for the opportunity to appear before you on behalf of the National Council of Teachers of Mathematics (NCTM). I am currently President of NCTM. I am a 35-year mathematics educator with experience as a middle school and high school mathematics teacher, a K–12 mathematics supervisor for a school district and, from 1983 to 1991, as Director for Mathematics for the Texas Education Agency, the state's department of education. From 1999 through 2001, I served as a Peace Corps volunteer teaching mathematics in Burkina Faso, West Africa. I feel privileged to address you on behalf of mathematics teachers on the importance of K–12 mathematics education in science, technology, engineering, and mathematics (STEM) fields and in aerospace.

The National Council of Teachers of Mathematics was founded in 1920 and today is the world's largest mathematics education organization, with nearly 100,000 members and 250 Affiliates throughout the United States and Canada. In 1989, NCTM was the first professional organization to develop and release standards for shaping content and instruction in K–12 mathematics programs with its *Curriculum and Evaluation Standards for School Mathematics*. More recently, in April 2000, NCTM published *Principles and Standards for School Mathematics*, which takes into account recent research on mathematics teaching and learning. The Council's mission is to provide the vision and leadership necessary to ensure a mathematics education of the highest quality for *all* students.

As several assessments and reports have documented, American students do not compare as favorably as we might wish with their international peers on measures of math and science achievement. After thoroughly examining those results, experts have concluded that our education system has two significant weaknesses. First, our curriculum is plentiful in terms of the topics covered but shallow in terms of the depth of understanding allowed or expected of students. And second, many of our teachers are ill prepared to teach math and science, and they have inadequate support with respect to appropriate professional development, especially in mathematics and science content.

The 2001 report, *Before It's Too Late: A Report to the Nation from the National Commission on Mathematics and Science Teaching for the 21st Century* was produced by blue-ribbon panel of educators, policymakers, and state leaders, led by Senator John Glenn. The Glenn Commission drew three key conclusions:

1. "The Commission is convinced that the future well-being of our nation and people depends not just on how well we educate our children generally, but on how well we educate them in mathematics and science specifically."
2. "Our children are falling behind; they are simply not 'world-class learners' when it comes to mathematics and science."
3. "The most powerful instrument for change, and therefore the place to begin, lies at the very core of education—*with teaching itself*."

While there are remarkable and laudable exceptions from which we can learn, in general our children are not receiving the world-class education in mathematics and the sciences that they deserve. This fact alone is serious, but the long-term implications on our nation's economic growth, STEM careers, workforce development, and on our citizens' basic quantitative, scientific, and technology literacy cannot be ignored.

Indeed, the nation faces a potential crisis that can be averted only with two major investments and one overarching commitment. First, we must invest in basic science and research on an unprecedented scale. Cuts in the federal investment in science have been accompanied by reductions in research on the part of several major pharmaceutical companies. While the United States scales back its scientific investments across budget categories, other nations, including some whose economy has never been considered competitive, are investing at unprecedented levels in order to enter the global marketplace fueled by intellectual and scientific activity.

Second, the United States must invest deeply and for the long term in educating all pre-K–12 students in a rich and effective education anchored in more mathematics and science than we ever imagined was necessary. However, simply increasing coursework requirements is not only inadequate, but dangerous. Requiring students to accumulate credits in subjects in which they have no foundation, while expecting teachers to teach more advanced mathematics and science courses without extensive additional knowledge and preparation, is a recipe for disaster. We risk driving both students and teachers out of the system. Instead, we must create a generation of teachers equipped to teach more rigorous mathematics and science in ways that make the subjects accessible and useful to students. And we must support students in reaching raised expectations with additional time, extra programs, and innovative teaching approaches.

Both of these investments have the potential to make a significant difference in the nation's future, but only if we face head-on our greatest educational challenge—eliminating the differences in achievement among socioeconomic, racial, ethnic, and language groups. Rather than using the term *achievement gap*, I would like to suggest new language that might help us realize the true cost of this unconscionable situation. Let us talk instead of *untapped potential*. What we face in this nation are far too many young people who have never had the opportunity to develop their talents or demonstrate what they know and can learn. It is only with a national commitment to realize this untapped potential—to close the achievement gap—that we will maintain our increasingly fragile hold on our international leadership position.

Realizing untapped potential starts by expecting all students to reach higher basic levels of learning. But it cannot end there. Once we allow all students to demonstrate what they can do, we will be able to identify many more stars than the current system allows. These stars, who can be found in every demographic category, can then be nurtured and supported in reaching the highest levels of academic and scientific achievement. In this way, an investment in all students, not just those already identified as successful, can create a much larger talent pool for advanced study than we currently

identify. Once before in our history, the United States tackled the challenge of preparing more scientists and engineers to advance the cause of space. As successful as our space efforts were in the 1960s and 1970s, however, our thinking then was too limited. We neglected to see the potential in all students, and instead focused on those who were already successful. Today's challenges are far greater, and they call for a much broader investment and an even stronger commitment. We now know that we must provide all students with a stronger education than before, engaging even those students who may seem to have no interest in school while nurturing and supporting every student to reach his or her full potential. We also know that these efforts cannot start with advanced mathematics and science at the secondary level, but must build toward a strong education from early efforts in preschool to learn how to communicate, reason, and think. And as we look toward space to motivate our commitment, we can also rest certain that we are preparing all students for rewarding choices on the ground, whether they go into a scientific field or not. Preparing students to be quantitative thinkers able to reason, solve problems, and create new knowledge enables them to follow any path they might choose as they become tomorrow's citizens, whether in space, in business, the arts, or in society.

Making the level of change called for today demands thinking that goes far beyond what once worked for some children. We must find a way to replicate effective practices and continue to build our knowledge of how to teach mathematics and science better. Indeed, we must break the stranglehold of one-way lectures and superficial knowledge that seems to grip both teachers and students. Teaching mathematics and science today will never work if we cling to the illusion of what we vaguely remember from 20, 30, 40 or 50 years ago. There have always been wonderful teachers, and some students learned well. But we have never had an educational system that adequately prepared all students to achieve high levels of mathematical and scientific proficiency. And we have never had to prepare students for a world like the one our students today will face tomorrow. We cannot even imagine what will be called for, but it seems clear that whatever it is will demand high-powered thinking, problem solving, and creativity.

Much discussion has centered on what is being done in Japan, Singapore, and China. We can learn lessons from our Asian counterparts, without copying what is being done by others. Here in the United States at the dawn of the 21st century, we have a rare opportunity. We have the potential to create a New American Education System—one that is grounded in knowledge and understanding, focused on results, anchored in our unique American culture, and dedicated to creativity and innovation. Such an educational system has never existed anywhere, but with a national will and a collaborative commitment, such an educational system is within our reach.

The National Council of Teachers of Mathematics has been working for many years to expand and improve the number and quality of mathematics teachers in our country. Even with this attention, it is notable that most teachers who teach mathematics do not consider themselves mathematics teachers, particularly those who are teaching at the elementary and middle school levels. And in many cases, they don't consider themselves qualified for the task of teaching mathematics. Often, the few who feel confident with the curriculum feel inadequate with respect to pedagogy. In other words,

their own knowledge of mathematics is not solid, and they simply don't know ways of teaching the subject effectively to their students. K–6 teachers in the United States, nearly all of whom are required to teach math, often have taken only one or possibly two mathematics courses, and they may have taken at most a single course in instructional methods for teaching mathematics. According to the *2000 National Survey of Science and Mathematics Education*, among teachers in grades 5 through 8, only 14 percent have a major in mathematics (and more than half hold less than a minor in the subject). Sadly, in grades 8 to 12 the situation is only slightly better.

We have all heard of the pending 2 million teacher shortage facing the nation. Math teachers top that list. Therefore, our task is doubly challenging. We must retrain those teachers now in the classroom and reinvigorate the training offered to students in the higher education pipeline. Sustained, focused teacher professional development programs need to be strengthened and expanded. Tax credits for teachers are a potentially effective, tangible means of providing a direct benefit to teachers already in the workforce, and they may provide some incentive to students considering teaching careers.

Most of all, if we are to take on the task of providing more well-qualified math and science teachers for the nation's classrooms, we need to provide support for teachers entering the profession. With over half of new teachers leaving the field within the first five years, addressing this issue should be among the nation's highest priorities. These are teachers who already represent a significant investment of time and money in becoming teachers and who are ready to step into a classroom in need. Finding ways to support these early career teachers can therefore be the most cost-effective avenue we can pursue in terms of providing more teachers in the classroom. Teachers leaving the field often cite political, community, and administrative pressures to undertake practices that do not mesh with what these teachers have learned in their teacher education programs. At the top of this list is pressure to raise test scores at any cost, rather than teaching a deep and solid foundation in mathematics that will serve students well throughout their school experience. Furthermore, in too many systems, the least experienced teachers are assigned the classes with the greatest needs. It is far more likely for a student in a poor or urban setting to be taught by an underqualified teacher than for a student in an affluent suburb. According to the Education Trust, in mathematics courses in high schools with large concentrations of minority students, 32 percent of the teachers lacked even a minor in mathematics, compared to 23 percent in mostly white schools. Any solution to the early teacher career crisis must address the broader system in which teachers operate, including the testing system, staffing and hiring practices, and the reward system. Math teachers (and soon science teachers) are particularly tempted to leave teaching, because math is part of state accountability systems, and adults with math and science backgrounds tend to have more alternatives outside education.

Just as reading competency forms the foundation for academic achievement of any kind, a sound foundation in mathematics is vital for success in the sciences, technology, engineering, and aerospace. Today's teachers of math and science are preparing our next generation of scientists, aerospace engineers, explorers, inventors, and

workers. According to the National Science Board, the demand for engineers and scientists over the next decade will outpace all other occupations by 100 percent. Bolstering math and science teaching will not solve all the problems of the future, but failing to do so carries a cost we simply cannot afford. Let us work together with a national will and a visible commitment to create a world-class generation of citizens and scientists.

Thank you for the opportunity to offer testimony and express NCTM's views on this important issue.

February 8, 2006

TESTIMONY PREPARED FOR THE AEROSPACE STATES ASSOCIATION ON K-12 SCIENCE, TECHNOLOGY, ENGINEERING AND MATHEMATICS (STEM) EDUCATION WITH AN EMPHASIS ON TECHNOLOGY, INNOVATION, DESIGN, AND ENGINEERING (TIDE).

Presented by Dr. Kendall N. Starkweather,
Executive Director of the International Technology Education Association

Chairman Leman, distinguished colleagues, friends, and leaders in the Aerospace States Association. Thank you for the privilege of providing testimony and addressing opportunities that are an important part of K-12 science, technology, engineering, and mathematics (STEM) education. My testimony will focus on creating the next generation technologist, innovator, designer, and engineer (TIDE). Traditionally, conventional wisdom has been that to produce more designers and engineers, you merely need to teach more science and mathematics. Today, we know that technological literacy has its own content base and that while technology-oriented fields such as engineering have content that relates to the science and mathematics disciplines, it also has its own uniqueness. That uniqueness creates the environment in which invention and innovation happen and is identified in terms of content in *Standards for Technological Literacy: Content for the Study of Technology*.

The aerospace industry is no stranger to innovations that have addressed many of the wants and needs of society. Innovation has always been a fundamental part of America and Americans have historically been world leaders in innovation. It has been said that if Americans were to stop innovating, they would stop being Americans. However, as a society, we have never before had a circumstance in which invention and innovation course content has been identified and placed into the school curriculum as is possible today. The real danger is that the lay public, legislators, and corporate leaders are unaware and have yet to provide real support for such a curriculum to be taught starting at the very earliest grades and progressing to the university level. In short, our nation's leaders did not have these experiences and subjects when they went to school, so it is difficult for them to envision the opportunities that such an education can provide.

We know that innovation can start at the very earliest ages—even toddlers will attempt to manipulate and adjust just about anything that they touch. That curiosity can and is channeled into meaningful experiences that build practice in designing, making, engineering, and innovating. At the same time, science and mathematics principles are utilized in these experiences. We are at a point in history when the reality of a STEM education has more meaning than ever as we work and live in a fast-moving, highly technological society. With these thoughts in mind, the following assumptions or realizations start to become a reality.

- That a nation's future and prosperity are inextricably tied to its ability to invent and innovate in a highly sophisticated, technological society.

- That innovation can be taught at the K-12 level, allowing students to think like creators, inventors, and designers.

- That engineering concepts can be taught at the earliest ages just as music, art, science, mathematics, and other school subjects are.

- That the engineering community has a content base and standards that are uniquely its own—known as technological literacy.

- That K-12 engineering and design is for ALL students.

- That K-12 teaching and learning can be directed towards creating a nation of thinkers with expertise in technology, innovation, design, and engineering (TIDE).

During the past decade, we have been able to make significant progress toward strengthening the technology and engineering part of a STEM education. This progress has included:

- Creating a rationale and structure for the study of technology.

- Creating standards for technological literacy that define what students should know and be able to do at the K-2, 3-5, 6-8, and 9-12 grades of education.

- Developing standards for professional development, assessment, and programs.

- Creating and testing standards-based curriculum in selected states with an emphasis on TIDE.

- Creating a consortium of states to develop technology/science/mathematics standards-based curricula with assessments to provide TIDE experiences.

- Working with teacher accrediting agencies to develop guidelines for higher education.

- Funding of technology and engineering projects by government agencies such as NSF and NASA.

- Creating a progression of 38,000 technology teachers moving towards the use of content standards for technological literacy and teaching about TIDE.

- Putting experiences and career options in place that will give students an opportunity to be key players in the next generation workforce as designers, engineers, architects, and hi-tech workers.

We must increasingly emphasize the benefits of molding students to become strong innovators. We should be actively promoting the teaching of invention and innovation in our classes. These school subjects are ground zero for developing a generation that will be better equipped to compete in a world of challenge and change. Innovation is not just a result of teaching more or better mathematics and science. We must educate about the design, engineering, and technology that generate true innovation.

The development of talent goes hand in hand with education. It should start at the very earliest ages and continue in an organized manner throughout life. The talent needed in the future will be much different from the industrial economy that we have experienced in the past. Therefore, our educational system should be looking at course work that reflects the kind of economy that will be key to our future workforce. People will be needed with different visions, approaches, and with action agendas. Any nation's talent must be stimulated to innovate and to take the lead in next-generation knowledge that occurs in concert with technological development.

In order to adjust our educational system to truly include a strong STEM education and to become a nation that continues to lead in engineering and innovation, we must:

- REALIZE that engineering and innovation have a content base, K-12 pipeline subject area, and an infrastructure that is uniquely its own.

- Internalize how teaching students about TIDE is a basis for creating a world of innovators.

- Take the lead at the K-12 level advocating for TIDE education in our schools.

- Inform parents, school boards, administrators, academia, and other publics, of how K-12 TIDE education contributes to our innovative culture.

- Educate fellow educators on the virtues and importance of innovation.

- Invite the corporate, manufacturing, scientific, and technological communities to be a part of this thrust to reform education and our future workforce.

- Advocate policy development and initiatives that enhance TIDE as a strong part of a STEM education.

We have a tremendous challenge ahead of us in expanding the next generation's intellectual capability and capacity through a STEM education. Along with this challenge, however, comes a tremendous opportunity to make the reforms and adjustments to our educational system to create meaningful experiences with a practical nature. That education starts with experiences for the very young that have already been a part of learning situations and continues through all grades to higher education. All we have to do is provide the policy and support to make such an education stronger.

Again, I thank you for the privilege and opportunity to address you on these important issues.

References

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Testimony was prepared by the International Technology Education Association and presented by Dr. Kendall N. Starkweather, Executive Director/CEO. ITEA is located at 1914 Association Drive, Reston, VA. 20191. www.iteaconnect.org. Email-kns@iteaconnect.org.

Presenters' Biographies

Associate Administrator, NASA
Rex Geveden

Rex Geveden is the Associate Administrator of the National Aeronautics and Space Administration. In this position, he is responsible for all technical operations of the Agency. He works directly with the Administrator to develop strategy and policy and has direct oversight of all NASA's programs and field centers.

Rex Geveden was formerly the NASA Chief Engineer. In that position he held agency responsibility for engineering policy, assessment, and development; project management policy, assessment, and development; independent program assessment; and execution of the Independent Technical Authority.

Mr. Geveden is the former Deputy Director of NASA's Marshall Space Flight Center in Huntsville, AL, where he was jointly responsible for managing one of NASA's largest field installations, with more than 6,500 civil service and contract employees and an annual budget of $2.3 billion. The Marshall Center is responsible for the Space Shuttle propulsion systems, major component development and payload operations of the International Space Station, development of next generation launch technologies, and an array of science and technology programs including the Chandra X-ray Observatory, Gravity Probe B, and mirror development and testing for the James Webb Space Telescope.

Previously, he was Deputy Director of the Science Directorate at Marshall where he led a government-industry workforce of over 600 in scientifically diverse research and development projects in space science, materials science, biotechnology, earth science, and space optics.

As Program Manager for Gravity Probe B (GP-B), he led a government, industry and university team in developing a sophisticated payload designed to test two features of Einstein's general relativity theory. GP-B launched in April 2004. He previously managed the Optical Transient Detector and Lightning Imaging Sensor flight projects, which were the first instruments to detect lightning on a global scale from space.

Geveden is the former manager of the Microgravity Science and Applications Department at Marshall. In this capacity, he led a government-industry team of 350 scientists, engineers, and project managers in a national space research program in materials science, radiation shielding, and biotechnology.

He joined NASA in 1990. He earned a bachelor's degree in engineering physics and a master's degree in physics from Murray State University in Kentucky, and is also a graduate of the Program Management Course at the Defense Systems Management College in Ft. Belvoir, VA.

Geveden has received many awards throughout his NASA career, including the NASA Outstanding Leadership Medal and the Silver Snoopy Award. He was the first NASA employee

to achieve Level IV Program Management certification and was selected for the Accelerated Leadership Option. Mr. Geveden is also an Associate Fellow of the American Institute of Aeronautics and Astronautics and won the Holger Toftoy award for outstanding technical leadership in 2004.

Angela Phillips Diaz
Acting Assistant Administrator for Education
NASA Headquarters
Washington, DC

Ms. Angela Phillips Diaz was appointed to serve as Acting Assistant Administrator for Education, NASA Headquarters on October 12, 2005. She is responsible for providing executive leadership to the Office of Education, ensuring policy direction, functional management, and guidance in coordinating the Agency's overall efforts to organize and enhance its education programs.

Prior to this assignment, she served as Deputy Assistant Administrator for Legislative Affairs, providing executive leadership and direction for NASA's overall Legislative and Government relations activities with responsibility for the daily management and operations of the Office of Legislative Affairs including budget, human resources/capital, and strategic planning.

In 2003, Ms. Diaz was named the Deputy Associate Administrator for Education, responsible for structuring the newly established Education Enterprise. She focused on the daily management and operations, including budget, evaluation, human resources, and strategic planning. In 2002, Ms. Diaz served as the Assistant Associate Administrator for Policy and Plans in the Office of Space Flight (OSF), NASA Headquarters. She was responsible for the initial design and start up of this newly established Office. She led OSF's policy formulation, implementation, and long-range strategic planning activities, as well as cross cutting external relations functions (education, public affairs, commercial use of space, congressional, international, and administrative management issues).

From 1998 to 2002, Ms. Diaz served as Director, Human Space Flight and Research Division, Office of External Relations, NASA Headquarters. She was responsible for executive leadership of international activities related to NASA's Human Exploration and Development of Space Enterprise. She provided policy advice to NASA leadership and negotiated significant international agreements for human space flight, life/microgravity sciences and applications programs. Ms. Diaz was also the lead negotiator for agreements with Canada, Europe, Japan, and Russia including the International Space Station Crew Code of Conduct.

Ms. Diaz served in leadership positions for several White House initiatives: first Executive Secretary, National Science and Technology Council (NSTC) and the President's Committee of Advisors on Science and Technology (PCAST) at the Office of Science and Technology Policy (OSTP); Executive Secretary, Committee on Education and Human Resources (CEHR), Federal Coordinating Committee on Science, Education, and Technology (FCCSET).

Ms. Diaz received her Bachelor and Master of Business Administration degrees from Marymount University of Virginia. She is a 2002 graduate of the Advanced Management Program at the Harvard University Business School and a 1989 Senior Executive Fellow of the John F. Kennedy School of Government, Harvard University. Her accomplishments are cited in the 2000 Notable American Women, Who's Who Registry of Rising Young Americans, and Outstanding Young Women of America; member of Delta Epsilon Sigma; President of Women in Aerospace (1995-1996); President of the Marymount University Alumni Advisory Board

(2001-2003); First Vice President of Marymount University MBA Association (2002-2005); Board member of the American Astronautical Society; member of American Institute of Aeronautics and Astronautics (International Activities Committee). She has been recognized with various honors including the Virginia Foundation for Independent Colleges Distinguished Alumni (2002), the NASA Outstanding Leadership Medal (2003), the Marymount University Alumni Achievement Award (2004), and the Meritorious Presidential Rank Award (2005).

Ann B. Carlson, Ph.D.
Senior Staff Associate for Policy and Planning
Office of the Director
National Science Foundation

At the National Science Foundation, Dr. Ann Carlson is responsible for providing the Director and the Deputy Director with broad policy-level advice, assistance, and support on a wide range of programmatic and budget planning matters relevant to the mission of the Foundation. Before joining the Foundation in 2005, Dr. Carlson served as a Senior Policy Analyst with the White House Office of Science and Technology Policy and National Aeronautics and Space Administration (NASA) Agency Representative to the National Science and Technology Council. In this capacity she coordinated science policy and interagency research activities primarily in the areas of the environment, social and behavioral sciences, and education and workforce development.

During her 25-year NASA career, Dr. Carlson served Assistant for Science Policy to NASA's Chief Scientist and in various program and line management positions for the Earth Sciences Enterprise at NASA Headquarters in Washington, DC and at Langley Research Center in Hampton, VA. She has worked variously as a research scientist in support of NASA's atmospheric science program and Principal Investigator of the Surface Solar Energy Project, as a computational fluid dynamicist in aerothermodynamics research, and as a design engineer for aircraft and spacecraft thermal control systems. She holds a Ph.D. in Aerospace Engineering from North Carolina State University.

Henry Johnson, Assistant Secretary
Elementary and Secondary Education—Biography

On June 1, 2005, Henry L. Johnson was nominated by President George W. Bush to be the assistant secretary for elementary and secondary education, and was confirmed by the Senate on July 28, 2005. As assistant secretary, Dr. Johnson plays a pivotal role in policy and management issues affecting elementary and secondary education. Specifically, he directs, coordinates and recommends policy for programs designed to assist state and local education agencies with: improving the achievement of elementary and secondary school students; helping ensure equal access to services leading to such improvement for all children, particularly children who are economically disadvantaged; fostering educational improvement at the state and local levels; and providing financial assistance to local education agencies whose local revenues are affected by federal activities. Prior to joining the Department, Dr. Johnson was the state superintendent of education for the state of Mississippi.

Dr. Johnson also served as the associate state superintendent of the North Carolina Department of Public Instruction, and as the assistant superintendent for curriculum and instruction for both the Johnston County Schools (N.C.), and the Pleasantville School System (N.J.). He has over 30 years of experience as a professional educator. This includes seven years as a science and mathematics classroom teacher, three years as a principal and two years as the director of middle schools programs for the Wake County (N.C.) School System. For five years, Dr. Johnson served as the director of policy development and research for the North Carolina School Boards Association.

Born in Tuscaloosa, Ala., Dr. Johnson was educated in the public schools of North Carolina. He earned his undergraduate degree in biology in 1968 at Livingstone College in Salisbury, N.C., and a master's degree in science education in 1975 at the University of North Carolina at Chapel Hill. In 1990, he received a doctorate in school administration at North Carolina State University.

Dr. Johnson is married and has two sons, a daughter and three grandchildren.

Dr. Gerald Wheeler

Executive Director, National Science Teachers Association

As the Executive Director of the National Science Teachers Association (NSTA), Dr. Wheeler heads the world's largest professional organization representing science educators of all grade levels.

Prior to joining NSTA, Dr. Wheeler was Director of the Science/Math Resource Center and Professor of Physics at Montana State University. He also headed the Public Understanding of Science and Technology Division at the American Association for the Advancement of Science (AAAS) and has served as President of the American Association of Physics Teachers (AAPT).

Dr. Wheeler received an undergraduate degree in science education from Boston University and a Master's degree in physics and a Ph.D. in experimental nuclear physics, both from the State University of New York at Stony Brook. Between undergraduate and graduate school, he taught high school physics, chemistry, and physical science.

For much of his career Dr. Wheeler has played a key role in the development of mass media projects that showcase science for students. He was involved in the creation of 3-2-1 Contact for the Children's Television Workshop, served on advisory boards for the Voyage of the Mimi and the PBS children's series CRO, and created and hosted Sidewalk Science, a television show for young people on CBS-affiliate WCAU-TV in Philadelphia. Dr. Wheeler has co-directed the National Teachers Enhancement Network, an NSF-funded distance learning project offering science and math courses nationwide.

Dr. Wheeler is the recipient of numerous awards for his teaching and mass media work, including outstanding teaching awards from Temple University, the University of Hartford, and Montana State University, as well as the AAPT Milliken Award. He is a fellow of the W. K. Kellogg Foundation and AAAS and has served on advisory boards and committees for the American Institute of Physics and the National Assessment of Educational Progress.
Dr. Wheeler's publications include numerous books, research and education articles, and reviews.

Dr. Cathy L. Seeley
President, National Council of Teachers of Mathematics

NCTM President Cathy Seeley is a 30-year mathematics educator who has taught at the middle and high school levels and has served as a K–12 mathematics supervisor. She was Director for Mathematics for the Texas Education Agency, the state's department of education, from 1983–91. She has also served as a director of policy and professional development for the Texas Statewide Systemic Initiative at the Charles A. Dana Center, University of Texas. Most recently she worked on the development of an online, project-based algebra program at the University of Texas at Austin. Before that, she spent 2 years as a Peace Corps volunteer teaching mathematics in Burkina Faso, West Africa.

Dr. Seeley has been involved in many state and national activities for the improvement of mathematics teaching, learning, and assessment. She led the mathematics writing team for the Texas Essential Knowledge and Skills (TEKS), the state's most recent curriculum standards. Seeley also chaired the Committee on Guidelines for Developing Curriculum Programs in Mathematics and Science for the National Research Council (1998–99).

Kendall Starkweather
Executive Director
International Technology Education Association

Dr. Kendall N. Starkweather is Executive Director of the International Technology Education Association (ITEA) located in Reston, Virginia. ITEA is the only major association in North America existing solely for the purpose of promoting technological literacy in our schools. As Executive Director, Dr. Starkweather is involved in association activities designed to advance ITEA's mission. He is publisher of the association's journals, The Technology Teacher and Technology and Children, which contain curriculum and instructional materials dealing with all aspects of technology.

His background includes high school teaching experience and nearly a decade of teacher education work at the University of Maryland. This work has been of value to him as he has interacted with other countries in problem-solving programs for technology.

Dr. Starkweather's efforts have been directed towards educational materials on such topics as problem-solving and technology, how technology affects people and the environment, controlling technological systems, and the impacts of technology on people and the environment. During this time, ITEA has grown in national and international prominence effecting a transition toward technology teaching.

Dr. Starkweather has been involved in an advisory capacity for such groups as the North Atlantic Treaty Organization, National Association for Science, Technology and Society, National Research Council, National Academy of Sciences, National Academy of Engineering, American Association for the Advancement of Science, National Science Foundation, National Science Teachers Association, Junior Engineering Technical Society, Challenger Center, and the National Aeronautics and Space Administration. Dr. Starkweather has been a member of the Board of Directors for the Autodesk Foundation, and for the Foundation for Technology Education. He has spoken on technology education in most states and provinces in North America, and has spoken or consulted in Australia, Canada, England, Greece, the Netherlands, Japan, New Zealand and Taiwan.

Dr. Starkweather's experience as an association executive has included work with the American Society for Association Executives' Key Professional Associations Committee (Chair 95-96), the International Section Council, the development of a Foundation for Technology Education, Trust for Insuring Educators' Executive Committee, development and responsibility for the Technology Education Advisory Council, and strategic planning for ITEA. Dr. Starkweather's experience as an educator and association executive has allowed him to work with others in doing what he enjoys the most - helping teachers and students reach their potential through a better understanding of technological issues and developments.