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NATIONAL OCEANIC AND ATMOSPHERIC ADMINISTRATION
U.S. DEPARTMENT OF COMMERCE**

**OVERSIGHT HEARING ON K-12 SCIENCE AND MATH
EDUCATION ACROSS THE FEDERAL AGENCIES**

**BEFORE THE
COMMITTEE ON SCIENCE
U.S. HOUSE OF REPRESENTATIVES**

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Mr. Chairman, and members of the Committee, thank you for inviting me to discuss the National Oceanic and Atmospheric Administration's (NOAA's) education program. I am Jack Kelly, Deputy Under Secretary for Oceans and Atmosphere. NOAA supports and appreciates the actions taken by members of the Committee to focus on academic excellence through Science, Technology, Engineering and Mathematics (STEM) education programs.

As a federal science agency that relies on a highly trained scientific and technical workforce, NOAA has a vested interest in encouraging young people to become interested in science and eventually pursue higher education and careers in science fields. NOAA believes that federal science agencies have a unique role to play in ensuring an integral connection between science and education.

As was articulated in *Blueprint for Change: Report from the National Conference on the Revolution in Earth and Space Science Education* (Barstow, 2002): "NASA, USGS, NOAA and other agencies have... [a] treasure trove of satellite imagery, animations, interactive maps and other visualizations for ready access by schools and the general public. The Internet helps students see how Earth's forces affect their daily lives and provides...links for further exploration. Such efforts should be continued and expanded, including developing related educational materials to help teachers and students take better advantage of these resources."

NOAA's mission is directed at serving our Nation's need for oceanic and atmospheric information to support economic, social, and environmental prosperity. Fulfilling this mission requires more than the delivery of accurate and precise scientific information; it also demands a public that is sufficiently empowered to translate scientific information into appropriate actions to protect lives, property, and the environment.

NOAA's education programs are focused on enhancing STEM education activities in subject areas where NOAA has unique expertise and where public responsiveness to warnings, forecasts, and stewardship efforts is important for meeting its mission. NOAA not only conducts scientific research and monitoring, but also manages marine areas that provide real world, practical connections between science and the environment. Public programs in these

natural laboratories build a stewardship ethic by showing how individuals' actions have direct impact on the environment. Because NOAA's mission is highly applied and directly related to decisions people make day to day, our education programs can highlight relationships between science and resource management decisions and forecasts and warnings. Further, NOAA's data and information services are provided on a consistent basis and have direct relevance to the events the general public experiences daily. This relevance makes the information of strong interest to educators as demonstrated by the roughly 6,000 requests from teachers, students and librarians for NOAA education materials that are received each year by the NOAA Outreach Unit in Silver Spring, MD.

In 2003, Vice Admiral Conrad C. Lautenbacher, Jr., U.S. Navy (Ret.), Under Secretary of Commerce for Oceans and Atmosphere, recognized a need to develop a formal education program in NOAA, reconstituted the NOAA Office of Education, and appointed a Director of Education, and established an Education Council. One of the primary goals of the office and council is to develop performance measurements for each education program in the agency to quantify their effectiveness. These entities are also responsible for coordinating education activities within NOAA and with other federal agencies, and serving as a single contact source for all education issues for NOAA. We also note that, while NOAA has authorities under specific programs, passage of the Administration's proposed NOAA Organic Act would provide permanent, NOAA-wide authority to disseminate information and conduct education and outreach.

NOAA invests in strategic education activities directed toward K-12 formal education and teacher professional development, opportunities for students pursuing STEM-related careers, and informal education activities in order to achieve our mission goals and promote development of a highly competent national workforce to support our future professional requirements.

In this testimony, I will focus on three areas where NOAA conducts education activities relevant to K-12 formal education and teacher professional development, higher education opportunities for students pursuing STEM-related careers, and informal education activities.

K-12 Formal Education and Teacher Professional Development

NOAA activities to enhance classroom-based STEM-related education are broadly focused on efforts to improve the degree to which NOAA-related disciplines are addressed in education standards, are infused in science curricula, and are present in teacher professional development. This multi-faceted approach is critical because reports suggest that few teachers are empowered to teach in STEM-related fields. *Before It Is Too Late: A Report to the Nation from the National Commission on Mathematics and Science Teaching for the 21st Century*, reports that more than one in four high school mathematics teachers and nearly one in five high school science teachers lack even a minor in their main teaching field. Furthermore, more than 12% of all new hires enter the classroom without any formal training; another 14% start work without meeting the teaching standards of their states.

Ocean Literacy is a joint public and private partnership effort to address deficiencies in the K-12 education standards highlighted by the U.S. Commission on Ocean Policy. This project represents the collective effort of numerous partners including NOAA and other federal

entities, the National Geographic Society, Centers for Ocean Sciences Education Excellence, and the National Marine Educators Association, to bring together the ocean community to identify the knowledge required to be considered ocean literate in accordance with the National Science Education Standards for K-12 education. This collective effort resulted in a definition of ocean literacy comprised of seven essential principles, supported by detailed fundamental concepts, which educators can use to fulfill the eight national science education standards and meet the science requirements of the No Child Left Behind Act, when those requirements take effect.

NOAA is building on its involvement in this effort by funding TERC, a private education research company, to assess the degree to which ocean sciences are currently represented in state science education standards. NOAA is also working with TERC to promote recognition of Earth science as a rigorous laboratory science course at the high school level. Although there are no nationally-recognized or nationally-adopted science education standards, in 1996 the National Research Council published recommended *National Science Education Standards*, which have formed a framework for the standards developed in some states. Earth science education is one of the three essential science areas addressed in the *National Science Education Standards* (NRC 1996) and preliminary results of an assessment commissioned by NOAA suggest that Earth science is included in every state's education standards. However, evidence shows that only 24% of our nation's students take a high school Earth science course prior to graduation, and Earth science is often times viewed as a less-rigorous course intended for non-college bound students. NOAA is supporting activities of TERC to revolutionize high school Earth science education by developing a model lab-based high school Earth system science course featuring a combination of field work, classroom experiments, and computer access to data and visualizations.

Through a partnership with the National Science Teachers Association (NSTA), NOAA provides supplemental education materials and improves teacher content knowledge in science topics relevant to NOAA's mission. Specifically, NOAA has already supported the development of classroom materials related to corals and estuaries, and several others related to climate and weather topics are in development. The concepts presented in these classroom materials will be reinforced by on-line and in-person teacher professional development courses and symposia offered through NSTA to their members. By partnering with the largest professional organization of science teachers in the United States, NOAA expands the impact of our science education activities by leveraging NSTA's expertise and extensive network of teachers.

NOAA partners with the American Meteorological Society (AMS) to create supplemental material for use in K-12 classrooms. NOAA has provided support to AMS's DataStreme Atmosphere and DataStreme Oceans programs, which train K-12 teachers in oceanic, atmospheric, and hydrologic sciences through pre-college teacher training and instructional resource material development. To date, over 100,000 teachers have received NOAA-relevant AMS training and instructional resources, which may help some teachers fulfill their Earth Science certification requirements and achieve "highly qualified" status under the No Child Left Behind Act.

The JASON Project receives support from NOAA to use multimedia tools and cutting-edge technology to engage middle school students in scientific research and expeditions led by leading scientists. Dr. Bob Ballard, discoverer of the sunken ocean liner *Titanic*, has transmitted his discoveries to millions of students in classrooms around the country, via satellite and internet broadcasts. The JASON Project also provides on-site and on-line teacher professional development supported by the National Science Teachers Association.

NOAA's Office of Ocean Exploration and Research (OE) has developed over 200 hands-on, inquiry-based lessons correlated to the National Science Education Standards. Scientists and educators explain the science behind each NOAA Ocean Exploration expedition for classrooms. The lessons are designed to introduce educators to ocean scientists and explorers, their research and explorations, and tools and resources that will interest students in NOAA-related science and exploration efforts. In 2004 alone, the Ocean Explorer Web site had requests for over 300,000 downloads of pages of these lessons. In 2005, the Education Section of the site tripled in bandwidth used due to dramatic increase in site usage. Formal evaluations conducted on this professional development program indicate that participating teachers felt better empowered to expose their students to "real" science. As a result, students report "discovery of a potential career area." Through the OceanAGE (Another Generation of Explorers) section of the Ocean Explorer Web site, students can interact virtually with the likes of Bob Ballard and Shirley Pomponi through video-based interviews as they learn why these premier ocean explorers chose careers in ocean science.

NOAA education also leverages public interest surrounding current events into educational opportunities. In 2005, after the Indonesian tsunami, NOAA developed and produced a tsunami education resources kit for K-12 teachers by compiling existing education materials and simulation models from across NOAA. To date, NOAA has distributed 8,000 kits to teachers nationally. This year, NOAA has produced a Hurricane Education packet in response to heightened national interest after Katrina and the record breaking 2005 tropical storm season. NOAA anticipates distribution of approximately 10,000 packets at the National Science Teachers Association meeting next week.

NOAA's local and regional facilities and fleet of ships and aircraft offer unique locations and platforms for teacher professional development opportunities. Since its inception in 1990, NOAA's Teacher at Sea program has enabled more than 430 teachers, from 47 states and 3 countries, to participate in real research and experience life at sea. Administered by NOAA's Office of Marine and Aviation Operations, the program gives teachers the chance to go to sea aboard NOAA research and survey vessels.

STEM-Related Higher Education Opportunities

NOAA actively serves students with a variety of opportunities to develop academic excellence and scientific rigor. Many graduates of these education programs continue their professional careers in the sciences and work for NOAA or partner institutions. The collective efforts of all these opportunities are aimed at increasing the size and diversity of the pool of future candidates for STEM-related professional positions.

NOAA's Educational Partnership Program began in 2001 and provides financial assistance, on a competitive basis, to Minority Serving Institutions (MSIs) to increase programs and opportunities for students to be trained and graduate in sciences that directly support NOAA's mission. The program consists of four core components: Cooperative Science Centers, Environmental Entrepreneurship Program, Graduate Sciences Program, and the Undergraduate Scholarship Program.

- Four Cooperative Science Centers have been designated at MSIs with graduate degree programs in NOAA-related sciences. To date, NOAA has provided formal training and research opportunities for 2,050 students at these centers. External teams of scientists have reviewed the centers to determine the effectiveness of student recruitment, training and graduation.
- The Environmental Entrepreneurship Program provides financial assistance to increase the number of students at MSIs who are proficient in both environmental studies and business enterprises. The Program facilitates linkages among MSIs, NOAA, and the private sector.
- The Graduate Sciences Program offers training and work experience to exceptional female and minority students pursuing advanced degrees in the environmental sciences. NOAA provides program participants with tuition, a housing allowance, travel expenses, and a salary for an annual 16-week work period at a NOAA facility, and the students are mentored by scientists while performing research. After completing the program, participants commit to employment at NOAA based on the length of their training. To date, the Graduate Sciences program has hired 27 graduates as NOAA scientists.
- The Undergraduate Scholarship Program has sponsored 69 students majoring in NOAA-related sciences at MSIs to obtain tuition assistance and participate in two ten-week summer internships. Forty-one students have completed the program, with 28 going on to graduate school.

The Dr. Nancy Foster Scholarship Program, named in honor of the late, distinguished NOAA scientist and Assistant Administrator, recognizes outstanding scholarship and encourages independent graduate level research – particularly by female and minority students – in oceanography, marine biology, and maritime archaeology. Congress authorized the Program, as described in the National Marine Sanctuaries Amendments Act of 2000, soon after Dr. Foster's death in June 2000, as a means of honoring her life's work and contribution to the nation. To date, 22 students have received scholarships, 18 of whom were women.

The National Sea Grant program offers several opportunities for graduate students through the John A. Knauss Marine Policy Fellowship. The Knauss fellowship, established in 1979, provides a unique educational experience for graduate students who have an interest in ocean, coastal, and Great Lakes resources and in the national policy decisions affecting those resources. The program places highly qualified graduate students at NOAA, NASA, the Department of the Interior, NSF, and Congressional offices for a one-year paid fellowship. The program is named in honor of one of Sea Grant's founders, former NOAA Administrator John A. Knauss. Since its inception, there have been over 550 Knauss fellows and annual program participation by females has averaged 71% since 2000.

The Ernest F. Hollings Scholarship Program recruits and prepares students for public service careers with NOAA and other natural resource and science agencies as well as for careers as teachers and educators in oceanic and atmospheric science. This year, the first Hollings Scholars are expected to participate in summer internships with NOAA labs and facilities. The Hollings Scholarship Program currently funds more than 100 students in ocean and atmospheric sciences, math, computer science, social science, and education.

Informal Education

NOAA's informal education activities provide educational experiences that typically involve taking students to unique settings outside of the classroom. Informal education combines well established educational methods with the excitement of hands-on activities and field experiences and develops life-long interest in the ocean and atmosphere. NOAA's informal education activities include hosting school children, community groups, and the general public at NOAA sites, supporting hands-on experiences in NOAA-related sciences, and increasing the inclusion of NOAA-related topics at science centers, museums, and aquaria.

NOAA is uniquely positioned to allow citizens to experience directly how a federal science agency manages our nation's natural resources and the importance of those resources. NOAA has 13 marine sanctuaries and 27 estuarine research reserves that provide students and the general public with hands-on experiences within these natural laboratories. These outdoor and engaging educational experiences provide direct application of the multi-disciplinary science NOAA conducts, and promote stewardship. School field trips to these sites enrich and supplement the classroom curriculum. Education coordinators at each site offer a variety of educational experiences tailored for the local community and school districts.

Programs such as Sea Grant, the National Marine Sanctuaries, and the National Estuarine Research Reserves offer comprehensive education programs that provide NOAA with the critical connection to the needs of the local communities that these place-based programs serve. These programs provide topically relevant and standards-based education programs and materials founded on an integration of NOAA's multi-disciplinary approach to understanding and predicting changes in the Earth's ecosystem.

Infusion of NOAA-related science topics into public venues for learning about science further promotes our ability to reach broad and diverse audiences and increase understanding of Earth system dynamics. One example of how we are increasing coverage of NOAA topics in museums, science centers, and aquaria is through public exhibits of NOAA's Science On a Sphere, a 3-D visualization tool of NOAA's global data. In June 2004, an evaluation of Science On a Sphere conducted at the Maryland Science Center indicated Science On a Sphere is a powerful and effective data visualization tool that engaged the public. Visitors reported significant increases in knowledge on Earth system dynamics and increases in their understanding about interconnections of these dynamics after viewing the Science On a Sphere exhibit. This program is providing us with an unprecedented opportunity to incorporate NOAA data and increase understanding about the Earth as an ecosystem.

NOAA's Need for STEM Education Improvements

In conclusion, thank you for this opportunity to describe NOAA's education programs with your committee. The successful performance of NOAA's mission depends on having access to the best meteorologists, oceanographers, cartographers, biologists, chemists, and engineers to conduct our work. Like many science-based agencies, many of NOAA's senior scientists are eligible for retirement this year. NOAA needs to attract well-qualified and trained candidates utilizing a variety of scholarship and fellowship programs that support education and training in NOAA-related sciences. The best way to ensure NOAA's scientific leadership and global expertise in oceanic and atmospheric research, observations, and forecasting, and environmental and ocean health, is to have the best and the brightest students, from a diversity of backgrounds, become fascinated with science education and the environment in which we live. NOAA's education program actively supports this objective.

That concludes my statement, Mr. Chairman. Thank you for the opportunity to present testimony on this topic. I am happy to respond to any questions the Committee may have.