

“Where Are We Going in Science Education?”

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Thank You Admiral Watkins and Commissioners for this invitation to address the U. S. Commission on Ocean Policy.

The National Science Teachers Association, NSTA, appreciates the invitation to participate on the Education Panel and to inform the deliberations of the U.S. Commission on Ocean Policy. We are pleased that the Commission understands the important connection between ocean policy and science education.

As NSTA’s Associate Executive Director for Professional Programs I am keenly aware of the important niche that the topic of oceans has in the scope and sequence of science education from Preschool through University programs. NSTA serves the entire science education community, including the PreK-University formal education community as well as an important and growing informal education community of professionals involved in a plethora of science museums, nature centers, aquaria, and other institutions.

The programs offered in these unique contexts contribute much to the experience base of a broad range of students and teachers by offering a variety of activities connecting their classroom studies to the ocean environment. Equally important, a very large population of adults have opportunities to extend their scientific literacy through engaging programs offered by these informal educators at their exciting institutions. Additional information about NSTA is found in the written testimony provided.

In an effort to underscore the importance of science education as an integral part of oceans policy, I would like to share a bit of historical perspective as to where science education has been, where we are now and where we are going. Although I will suggest the broad strokes of science education in general, I will attempt to site specific examples of ocean connections to illustrate the important ways in which this commission can effect the important science and science education interface.

Perhaps to illustrate the wide geographic scope of oceans education I should mention that by growing up in Nebraska and spending much of my teaching career in the Shawnee Mission Public Schools of Kansas, I was certainly distance removed from a live ocean. However, the ocean environment was always near by as my students and I spent a great deal of time interacting directly with the tallgrass prairie and deciduous forest ecotone in the school outdoor laboratory that we were successful in establishing. After all, we were walking on the bottom of an ancient ocean!

As we chipped away at the layers of Cretaceous limestone deposits and discovered fossils of ancient ocean critters, including a nearly complete fossil skeleton of a mosasaur, the “Kansas Nessie”, as described by my students, we were enlightened through our direct interactions with the local environment. At the same time, this local context helped in building our mental schema of earth systems as we realized that the limestone “fence posts” that we added to our school Outdoor Laboratory, from the famous “post rock” country of the Kansas Flint Hills region, were an important link in the complex ecological cycles so important in the operation of “spaceship earth”.

The easily observed fossils in these ancient sedimentary deposits led to further investigations and through the use of good curriculum and support resources many of these so-called “landlocked” students, began to realize the specific ways that the mineral deposits in the ancient oceans had an impact on the development of their local prairie and its chemically rich soil. Further extensions of the role that they and their prairie environment were having on the current ocean environment were now more understandable. Where does that silt from the erosion so evident in a booming suburbia go? What are the effects of “flushings” of biological and chemical wastes on the local freshwater environment or farther downstream on the estuaries and oceans?

As a teacher of science, you attempt to assess what your students have learned, in my case, about basic ecological principles. You are rewarded as you witness understanding breakthroughs that you see happening in a rich experiential education environment, and you take pride in the achievements of your students. Please allow me to cite a specific example that I would like to use to illustrate the importance of engaging young people in active science educational opportunities.

Although we were distance challenged, PBS and other TV specials brought us closer to the ocean. Speakers such as Jacques and Phillippe Cousteau, Eugenie Clark, and others, provided motivating and content rich topics at the NSTA conventions and conferences that I attended. Dr. Robert Ballard, one of your Commissioners, has been a long time friend of NSTA and a frequent featured speaker at our conferences. I had the pleasure of

meeting Dr. Ballard at our Anchorage AK NSTA conference shortly after his discovery of the Titanic.

My interest in experiencing first hand all of the biomes that I addressed in my biology classes led me to participate in a snorkeling excursion in the marine environment. This experience that I shared with other science educators along the undersea trails in the Virgin Islands National Park was quite a feat for this “non-swimmer”! I was pleased to be able to share my direct experiences and photographs of this biome with my students.

Students and teacher were together as we traveled the seas of “Calypso” with the music of John Denver...

“To sail on a dream of a crystal clear ocean
To ride on the crest of the wild raging storm
To work in the service of life and the living
In search of the answers to questions unknown
To be part of the movement and part of the growing
Part of beginning to understand... Aye Calypso...”

I’m confident that many of these vicarious travels that I led in my classroom motivated many of my former students to seek similar experiences themselves.

However, it was the reading of an article by Carl Sagan that caught the attention of “Jenny”, a student in my high school Biology class during her freshman year. Instead of his typical topic of stars, this article by Dr. Sagan, featured the “billions and billions“ of diatoms and other ocean plankton. What Jenny had circled, when she brought the article to me as part of an assignment, was a reference that he had made hypothesizing the effects of the ozone depletion discoveries on the photosynthetic productivity of the basic producer community of the ocean due to the increased UV-B radiation potentially available.

Persistent and dedicated to her interest in science, we soon had actively growing cultures of marine diatoms in our Biology Laboratory at Shawnee Mission Northwest High School in Kansas. Local science fair and symposium competitions were climaxed with a first place finish by a deservedly proud, Jennifer Reardon, at the International Science and Engineering Fair. Communications with scientists around the world led to apparatus loans and good research advice from scientists in California and Hawaii. Continued pursuit of her interests led to an opportunity to have her own undergraduate research laboratory as a freshman at the University of Kansas, with added summer field experiences in Hawaii. With her added interest and involvement in student government and politics, my web search recently confirmed the addition of science policy program extensions in her doctoral pursuits at Cornell and Harvard.

Of course teachers love to cite such success stories, but I believe that it is important in this context, since the future “Dr. Jenny’s” will be needed many fold as ocean policies are implemented. There are other important lessons learned from this example. Jenny, and

her teacher, had the good fortune to have the active involvement of scientists. Similar outreach efforts have been broadly documented. A number of these programs were carefully examined by a National Academy of Science/ National Research Council Committee, and published in: “The Role of Scientists in the Professional Development of Science Teachers”.

NSTA teamed up with Bayer in 1999 to survey our members on many topics, including the role of scientists in the classroom. According to the survey, science teachers say they look to scientists to help strengthen science education. They say that working directly with scientists offers substantial benefits for both their students and themselves. They agree that working with scientists helps students better understand science content and peaks their interest in the subject. The experience, say teachers, also provides students with positive role models and solid information about science as a career. The engagement of scientists can help students learn first hand about a career in ocean science.

Supportive school curriculum materials and science education programs that extend the experiential base, such as those I was privileged to be involved in, are important to challenge all students. Quality science education programs provide the appropriately active “doing of science” experiences as opposed to the often used, passive approach of “read, rote, and regurgitate”.

It should be noted that the timing of my preservice teacher training was supported during the “post-Sputnik” period by student loans made available as part of the National Defense Education Act, NDEA. Additional monies from this extended national legislative effort provided impetus for many inquiry based science curriculum projects, such as the development of the Biological Sciences Curriculum Study, BSCS, and other such projects. The well-stocked laboratories that served these inquiry approaches were supported by NDEA grants as another means to upgrade science and mathematics education. Professional development training in the use of these materials during this era of science education advancement was also available to me through National Science Foundation supported Summer Institutes. As a capstone to my early career training, I was able to complete a Master’s Degree in Science Education at the University of Oklahoma funded by a similar NSF Academic Year Fellowship. Unfortunately, the myriad of support systems available at that time withered prior to reaching a critical scale up stage. A revisit to the lessons learned from these programs, and subsequent, “best practices” is recommended during this time of science and ocean education strategic planning.

Not all science students should be expected to become scientists, and certainly not all science fair winners become Nobel Prize Winners. In my teaching experience it was very evident that the active engagement of students in “doing science” led to a deep and sincere appreciation of the process that has blazed the pathway for our economic progress and self well-being.

The effort to enhance the scientific literacy of the nation’s citizenry was underscored in the initiative to develop the National Science Education Standards brought forward and

supported by NSTA to the National Academy of Science. The result of the collaborative effort between the science and science education communities has been the rededication to involve ALL students in quality science learning programs. It is a necessity that all students, and all citizens, become science literate. It is the key to tomorrow's skilled workforce, strong economy, national security, and general well being. A public that has a science rich literacy will be vital to the successful implementation of the recommendations forthcoming from this U.S. Commission on Ocean Policy.

Although not all ocean science content is included in the K-12 National Science Education Standards, NSES, it is evident that topics of ocean science are encompassed in the content standards at every grade level. The NSES provides the needed cohesive vision that encourages teachers to provide the right kinds of materials at the proper grade level. NSTA has been a leader in shaping this vision into practice through a series of "pathways" publications that extend recommendations through the collegiate level.

NSTA has the support of 92 Chapters and Associated Groups and seven Affiliated organizations whose memberships encompass all arenas of science education across the United States and Canada. One of our Associated Groups, the National Marine Educators Association, NMEA, brings together those interested in the study and enjoyment of the world of water. Their Journal of Marine Education, current, is highly valued by science education professionals. A recent issue provided keen insight into the Centers for Ocean Sciences Education Excellence, COSEE, supported by the National Science Foundation.

A number of our current and past NSTA Board and Council members and both formal and informal educators are actively engaged within NMEA. Their journal articles, conferences and symposia provide meaningful support to science educators. An NMEA mini-symposium, Scientists and K-12 Education: Making the Connection, provided testimonial support from active scientists who were successful in outreach efforts to teachers and students.

At NSTA, we know how to improve student performance in science: we must ensure that every child has a quality teacher. Quality teachers of science must have a firm command of the content they are teaching, sustained professional development for continued learning, and time in the school day to plan, strategize and collaborate with their colleagues. Teachers must be active leaders in their community, being advocates for meaningful professional development, seeking administrative support for quality teaching efforts. We are also challenged by the data collected and the recommendations made by the Glenn Commission in its report, "Before It's Too Late". Paradoxically we seek higher standards for teaching at the same time we are confronted with many science teachers teaching outside of their area of major preparation.

NSTA is working to make quality teaching the cornerstone of America's effort to improve education and we are advocating for the support and resources to make it happen. We are appreciative of the intense and sustaining interest of the broad scientific community as demonstrated in examples that follow.

Federal and state government agencies play an important role in supporting science education. In addition to those mentioned elsewhere, a range of programs provided by NOAA, NASA, EPA, and other agencies have made unique contributions to the professional development and enhancement of teachers of science. NSTA members cite with great enthusiasm their involvement in programs such as the Teacher at Sea Program supported by NOAA and the NASA Educational Workshops, NEW, supported by NASA and implemented with a cooperative agreement with NSTA. These and other such programs bolster the confidence and motivate teachers of science through value added contributions in the professional development of teachers.

NSTA values the contributions made by scientists involved in government agencies at all levels as well as those active from the private sector. Corporate America has demonstrated its willingness to be a powerful advocate of policies, programs and investments that support quality teaching, including professional development. Generous financial and service support has been garnered from both the public and private sectors as NSTA has launched a major initiative that includes a professional development portal for science educators within The NSTA Institute. Offering onsite and online opportunities for sustained professional involvement, NSTA provides an important network supporting the enhancement of science teaching and learning. Online course offerings related to ocean science from the JASON Academy are provided. Further connections with our journals, publications, national, regional and state science education conferences will be used to further advance the best practices learned by researching professional development programs.

Technology support has greatly expanded the opportunities to learn about the oceans. The JASON Project has been noteworthy in using advanced technology to bring students in touch with ocean discoveries. The enthusiasm of science learning is contagiously spread between teachers, students and their parents in this extensive collaborative partnership with formal and informal institutions. The Hawaii Department of Education's KidScience program offers an interactive distance learning science program where students interact with scientists on electronic field trips. Technology provides unique opportunities for students and teachers to be engaged in geographically distributed data collection and analysis through GLOBE and other related projects.

Through its SciLinks initiative, NSTA has established criteria for selection and inclusion of approved web sites created in large part by the scientific and academic communities. Many content and pedagogical rich resources are made available to students and their teachers as key science concepts are examined. Careful consideration is made in selecting web sites that are in appropriate alignment with the national standards and state based science education frameworks. NSTA's SciLinks have been widely recognized in the science community as an opportunity for scientists to contribute to quality science education products.

Web sites such as NOAA's Ocean Explorer (<http://oceanexplorer.noaa.gov/>) provide the latest news of ocean discoveries and exploration videos. "Live from the Estuary", virtual field trips, are provided by North Carolina's National Estuarine Research Reserve.

(www.estuary/live.org/) A wealth of quality science education resources are readily available for all students provided that the technology support infrastructure, including teacher training, is available within the schools. The live ocean is now available “virtually” to Kansas too!

NSTA values these many contributions and offers a challenge that the results of these, and other exemplary science education programs, be used by the U.S. Commission on Ocean Policy in its deliberations. Recommendations from this body, for a coordinated and comprehensive national ocean policy, promoting the important goals provided in the purpose of establishing this commission, in the Oceans Act of 2000, must embrace the science education initiatives cited above.

The recently enacted federal legislation, No Child Left Behind, promises to bring changes to schools nationwide. There are key changes that impact science education initiatives. The law requires states to develop plans with measurable objectives that will ensure that science teachers are “highly qualified” by the end of the 2005-2006 school year. States must administer an annual assessment of student achievement in science at least once in grades 3-5, 6-9, and 10-12, beginning in 2007. Although the set aside provision for science and mathematics programs under the former Eisenhower grants are no longer available, Congress fully intended that Title II grant funds continue to be used for science education.

NSTA is urging science teachers to become proactive in their professional development by working with their schools, their districts and their administrators to decide how to best use federal education funds. Needs assessment must be made of the teachers’ professional development to inform the development of a Local Improvement Plan. The individual teacher’s plan should be used when developing the school and district improvements.

It is critical that the many valued science education reforms, supported by a large body of scientific and educational research, be aligned in the effort to improve the schools of our nation. To that end, quality teachers of science must be fully and continually prepared and supported in the delivery of exciting inquiry based programs. Tapping the natural curiosity of young people, engaging science education programs can whet the aptitudes of our students to pursue science careers and result in the ultimate goal of a well-informed and scientifically literate nation.

The forthcoming recommendations from the U.S. Commission on Ocean Policy can play a significant role in guiding public policy for protection and stewardship of the oceans through investment in science education for all its citizens. The National Science Teachers Association congratulates your effort to include the teaching and learning of science as a key component in the development of the recommendations. We join our colleagues in our Chapters and Associated Groups and our Affiliate Organizations in anticipation of the recommendations and pledge our support in charting the course of enhanced science education involvement in the ocean environment.

About the National Science Teachers Association

The National Science Teachers Association (NSTA), founded in 1944 and headquartered in Arlington, Virginia, is the largest organization in the world promoting excellence and innovation in science teaching and learning for all. NSTA's current membership of more than 53,000 includes science teachers, science supervisors, administrators, scientists, business and industry representatives, and others involved in science education. NSTA works to enhance and support the science teaching profession in the following four areas.

Enhance Professional Development

NSTA's National Science Teaching Institute offers professional development opportunities that are sustained, intensive, and tied to state and national standards. Its array of interconnected programs, such as topical conferences, workshops, and online courses now offered by Montana State University and the JASON Academy for Science Teaching and Learning, immerse teachers in valuable learning experiences. NSTA also holds world-class conventions that attract more than 30,000 attendees annually, along with summer-based professional development programs offered in partnership with organizations like NASA, NSF, and the FDA.

Develop and Channel Resources

Through its publishing arm, NSTA Press®, the Association produces four award-winning journals, a newspaper, and many books and publications for teachers of all grade levels. It also maintains a content-rich Web site (www.nsta.org) that provides grade-specific resources for teachers, the latest news and information affecting science education, and opportunities for educators to connect with one another. New to the Web site is NSTA Recommends®, which provides teacher reviews of the best science books, CD-ROMs, and other materials currently on the market. The NSTA Web site features NSTA's SciLinks initiative (www.scilinks.org), which connects textbook material to NSTA-approved Web sites that can enrich student learning both inside and outside the science classroom. NSTA also has grant and recognition programs that support and honor dedicated teachers and innovative student projects.

Connect Teachers

To connect teachers and promote the vision of the *National Science Education Standards*, NSTA partners with public and private organizations on its largest outreach program, *Building a Presence for Science*. Funded in large part by the ExxonMobil Foundation, the program works to improve science education nationwide by identifying advocates for science in every school building in the country.

Advocate for the Needs of Science Educators

NSTA disseminates results from national surveys and reports, presents testimony to Congress, and reaches more than 40,000 subscribers with its electronic *Legislative Update*, which reports the latest news about legislative activities affecting science education. In addition, NSTA has published position statements on important issues, such as teacher preparation, the teaching of evolution, and laboratory safety.