



National Association of Marine Laboratories

February 29, 2008

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Thank you very much for your letter of September 13, 2007 in which you requested advice from the National Association of Marine Laboratories (NAML) related to ocean, coastal and Great Lakes education.

NAML – through its Education and Diversity Committee – has developed the enclosed “white paper” outlining NAML’s role in ocean education along with a number of recommendations for NOAA to consider as it moves ahead to execute its new Congressional mandate in the area of education.

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The individual members of NAML – who are experienced and engaged in a number of ocean education activities – stand ready to use our experience and connections with students, faculty, and our neighboring communities to assist NOAA in carrying out its mandate in education.

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We appreciate very much the opportunity to provide these recommendations and look forward to continuing to work with you and your office as these programs move forward. We would be pleased to meet with you to discuss these recommendations in more detail if that would be helpful. Please let me know if you would like for me to arrange another meeting for you with our membership.

Sincerely,

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Ocean Literate America

A Whitepaper in Support of

The National Oceanic and Atmospheric Administration's

Ocean Education Mission

Submitted by:

The National Association of Marine Laboratories



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I. Oceans and Science Education

The scores of U.S. students in science and math are being eclipsed by those of students in other industrialized countries. This stark reality was driven home by the recent release of the Program for International Student Assessment's report of science, reading and mathematics tests given to 15 year olds from 30 industrialized countries. U.S. students ranked 17th in science and 24th in math scores. "Our students' performance today is the best indicator of America's global competitiveness tomorrow," said Raymond Scheppach, executive director of the National Governors Association.

The fundamental necessity to develop effective approaches that improve science education and link advances in science with education has emerged as a critically important issue over the past two decades. This need was noted in the report of the Research to Applications Task Force of the Ocean Research and Resources Advisory Panel (ORRAP) and been reported in an increasing number of documents including *Science for All Americans* (AAAS, 1990), *NSF in a Changing World* (NSF, 1995), *Geoscience Education: A Recommended Strategy* (NSF, 1997) and *NSF Geosciences Beyond 2000* (NSF, 2000). A major step in promoting the link between research and education was the establishment of "Criterion Two" or "Broader Impacts" as an important metric to judge proposals submitted to NSF that made the development of education and outreach activities and materials integral components of research proposals.

The oceans – and by "oceans" we mean in this document oceans, coastal areas, and the Great Lakes – have been recognized as an extremely effective arena for science education. This effectiveness is due, in large part, to the inherent interdisciplinary nature provided by the three-dimensional fluid coupling of physical, geological, chemical and biological attributes (Farrington, 1990), the broad general interest of the general public in these areas, and the fact that over 50 percent of the U.S. population lives in coastal areas. The challenges of working in the alien underwater world also require the application and innovation of technologies, further making the study of the oceans engaging for science, technology, engineering and mathematics (STEM) education (Humphris, 2001).

The role of the oceans in our daily lives is more evident everyday and forms the foundation of what is considered to be an ocean literate populace. The recent Ocean Literacy Initiative states: "Ocean literacy is an understanding of the ocean's influence on you and your influence on the ocean." From climate change, to healthy and adequate drinking water, to coastal buffers, to safe seafood and recreation, the range and value of the goods and services the ocean provides is becoming clearer. The need for an ocean literate society has been widely recognized and recent calls to action have shown us the way forward. Notable among these efforts are the following:

A. The Commission Reports

The landmark 2004 report of the U.S. Commission on Ocean Policy, *An Ocean Blueprint for the 21st Century*, dedicated an entire chapter entitled “Promoting Lifelong Ocean Education” to a broad suite of topics including: 1) Strengthening the Nation’s Ocean Awareness, 2) Building a Collaborative Ocean Education Network, 3) Incorporating Oceans into K-12 Education, 4) Investing in Higher Education and the Future Ocean Workforce, and 5) Bringing the Ocean and Coasts to All Americans. The chapter included seventeen recommendations to implement these elements. Similarly, the 2003 Pew Ocean Commission’s report *America’s Living Oceans: Charting a Course for Sea Change* included similar recommendations to “broaden ocean education and awareness through a commitment to teach and learn about our oceans, at all levels of society.”

A follow-up to the two commissions’ efforts, the Joint Ocean Commission Initiative (JOCI), noted in its report *From Sea to Shining Sea: Policies for Ocean Science Reform*, “An increased investment in ocean-related education will play a key role in stimulating a new generation of engineers and scientists who will help this nation maintain its technological lead in an increasingly competitive world while also helping to establish a new ocean stewardship ethic.” Despite its overall score of D+ for Ocean Research, Science and Education, the Joint Ocean Commission’s 2006 Ocean Report Card noted the formation of a “New interagency working group leading development of national strategy on ocean education.”

B. U.S. Ocean Action Plan

On December 17, 2004 the Bush Administration released the U.S. Ocean Action Plan in response to the U.S. Ocean Commission Report. The Plan laid out a new structure for ocean governance that included establishment of a new Committee on Ocean Policy and an Interagency Committee on Ocean Science and Resource Management Integration comprised of the Joint Subcommittee on Ocean Science and Technology, the Subcommittee on Integrated Management of Ocean Resources, and an expanded version of the Ocean Research Advisory Panel. The Action Plan also included support for lifelong ocean education and recognized an expanded authority for NOAA for education and outreach as outlined in the 2005 Consolidated Appropriations Act. The Plan also supported the Ocean Science Initiative at the Smithsonian Institution and expanded the Coastal America Learning Center Network.

C. U.S. Competitiveness and Science and Mathematics Education – The American Competitiveness Initiative

In 2005 the Congress requested the assistance of the National Academies of Science (NAS) to identify what steps should be taken to ensure the preeminence of America’s science and technology enterprise. The Academies responded with the landmark report entitled, “Rising Above the Gathering Storm,” which, among other issues focused on: 1) K–12 education (*10,000 Teachers, 10 Million Minds*), 2) research (*Sowing the Seeds*), 3) higher education (*Best and Brightest*), and 4) economic policy (*Incentives for Innovation*) and suggested 20 steps to implement these recommendations.

Among the recommendations to improve K-12 education were to: 1) recruit 10,000 new science and mathematics teachers by providing four-year scholarships, 2) improve the capacity of a quarter of a million existing teachers through a variety of successful methods including summer institutes, master's programs, and Advanced Placement (AP) and International Baccalaureate (IB) training programs, and 3) prepare more middle and high school students to pursue degrees in science, engineering or mathematics through AP and IB courses.

One of the other four most important action items to ensure future U.S. competitiveness focused on higher education and ways to continue U.S. leadership in science research is to attract the best and brightest from within the U.S. and around to world. Among the incentives to reach this goal were: 1) providing 25,000 new 4-year competitive undergraduate scholarships each year to U.S. citizens attending U.S. institutions, 2) funding 5,000 new graduate fellowships each year in "areas of national need," 3) encouraging employers to make continuing education available to practicing scientists and engineers, and 4) improving visa processing for international students.

In response to the Academies' report the Bush Administration developed the American Competitiveness Initiative (ACI) and included increased funding levels for mathematics and the physical sciences in its fiscal year 2008 and 2009 budget requests. The core elements of the ACI were codified into law by the America COMPETES Act (Public Law 110-69) in August, 2007.

D. The Conference on Ocean Literacy

The Conference on Ocean Literacy (CoOL) was a watershed event in ocean education held on June 7-8, 2006 in Washington, DC. A total of twelve federal and non-federal sponsors supported the event intended to be a next step in developing a national strategy for ocean literacy, following the recommendations of the U.S. Ocean Commission's Report and the President's Ocean Action Plan. The two day event featured five plenary sessions and five moderated panels. The report of the Conference set forth a number of key recommendations including:

Formal Education: Creating Ocean-Literate Students

- Get involved at all levels
- Focus on teachers
- Connect to Earth system science, environmental education, and other science education initiatives
- Scale up to reach larger audiences of teachers and students
- Engage and coordinate efforts of the Federal government

Informal Education: Creating an Ocean-Literate Society

- Create and deliver unified messages

Building an Innovative Workforce through Diversity

- Ask the right questions
- Link marine laboratories and minority serving institutions
- Include community colleges
- Develop an Excellence in Science award

Regional Approaches to Ocean Literacy

- Strengthen regional networks
- Develop coordinated messages on the relevance and importance of the world's ocean, coasts, and watersheds – including the Great Lakes

II. NOAA and Ocean Science Education

The National Oceanic and Atmospheric Administration (NOAA) is widely recognized as one of our nation's leading supporters of ocean research and monitoring, particularly in the realm of applied science to meet specific management goals, many established through Congressional requirements. Despite having developed a number of educational programs through its line offices, NOAA as an agency was only recently authorized by Congress to support ocean education as a result of the enactment of the America COMPETES Act. This Act gives NOAA broad latitude to “conduct, develop, support, promote, and coordinate formal and informal educational activities at all levels to enhance public awareness and understanding of ocean, coastal, Great Lakes, and atmospheric science and stewardship by the general public and other coastal stakeholders, including underrepresented groups in ocean and atmospheric science and policy careers. In conducting those activities, the Administrator shall build upon the educational programs and activities of the agency.” Furthermore, the Act charges: “The Administrator, appropriate National Oceanic and Atmospheric Administration programs, ocean atmospheric science and education experts, and interested members of the public shall develop a science education plan setting forth education goals and strategies for the Administration, as well as programmatic actions to carry out such goals and priorities over the next 20 years, and evaluate and update such plan every 5 years.”

III. The National Association of Marine Laboratories' (NAML) Role in Ocean Education

NAML is a nonprofit organization of about 100 members employing more than 10,000 scientists, engineers, and professionals and representing ocean, coastal and Great Lakes laboratories nationwide. NAML labs support the conduct of high quality ocean, coastal and Great Lakes research and education in the natural and social sciences and the effective use of that science for decision-making on important issues facing our country. Many NAML labs are co-located with, or linked to, NOAA laboratories. The location of the labs on the diverse mosaic of habitats along the coasts makes them natural “windows on the sea,” bringing the excitement of the oceans and Great Lakes to all Americans.

A. NAML's Education and Outreach Mission

NAML's education mission is two-fold: to provide enhanced ocean-related education so that all citizens recognize the role of the oceans, coasts, and Great Lakes in their own lives and the impacts they themselves have on these environments; and to provide formal research and training opportunities at K-12, college, and post-graduate levels to ensure a technically-qualified, and ethnically diverse workforce capable of solving problems and answering questions related to the protection, restoration, and management of coastal and ocean resources, climate variability, and society's needs.

Within this broad education and outreach mission, NAML Laboratories strive to:

- enhance public understanding of ocean, coastal and Great Lakes issues and the impact those issues have on society;
- interest more K-16 students in science, technology, engineering and math—the STEM disciplines so vitally important to the future economic competitiveness of this country;
- provide superior teacher training in the STEM disciplines;
- involve K-16 students and teachers in research, education, and outreach projects; and
- share success stories across the NAML network to maximize the impact of our programs at the local, state, regional, national, and international levels.

B. NAML Labs as Centers for Ocean Education

As a network of marine laboratories that embrace ocean education and outreach as well as research, NAML is informally linked to other federal and non-federal ocean education networks (e.g. Sea Grant, NSF-sponsored Centers for Ocean Science Education Excellence, NSF-sponsored Research Experiences for Undergraduates/Research Experiences for Teacher programs, public aquaria and zoos). NAML is positioned to build more formal linkages and strengthen the national networks. As “windows on the sea” the NAML labs provide natural laboratories and classrooms for experiential education recognized as a critical means to engage learners (Agassiz's Legacy, Gladfelter, 2002; Klug et al. 2004).

C. NAML Education and Diversity Committee

In 2007 NAML established its Education and Diversity Committee (EDC). The EDC is charged with advising NAML on issues pertaining to education and diversity as they relate to ocean, coastal and Great Lakes research and education. Activities include but are not limited to: guiding NAML's annual public policy agenda so that it includes the appropriate education and diversity elements; monitoring reports, workshops and other events, and ensuring that NAML participates when appropriate; taking the lead on drafting official comment to education and diversity related reports, etc. on behalf of NAML; and any other activities that may arise. The EDC is tasked with recognizing and promoting the unique role that coastal laboratories play in conducting education, outreach, and public service.

Though only recently established, the EDC has been active in developing working groups that include outside experts to address important challenges in ocean education including future workforce needs and participation by underrepresented groups. One of the initial working groups developed a proposal for the Ernest Everett Just National Medal of Excellence. Through this award, NAML and its partners will bring national attention to a noted scientist of color who worked with marine life at marine laboratories. The award is intended to recognize the contributions made by visiting researchers at marine labs and by recognizing the pioneering efforts of E.E. Just, increase participation of and leadership by individuals from underrepresented groups in ocean science, education, and policy. This proposal was recently approved at NAML's Biennial Meeting in October 2007. The NOAA Education Office can support this effort and the award through its many education programs and by helping to find other federal and non-federal partners to support this initiative.

The Biennial meeting also provided the opportunity to develop stronger relationships with the NSF Louis Stokes Alliances for Minority Participation through discussions with program director Dr. James Hicks.

Another NAML EDC working group has focused on the development of this NOAA Education whitepaper. Members of this working group are listed in Appendix A.

IV. Moving Forward – a NOAA and NAML Education Strategy

Below are specific recommendations for collaboration between NOAA, NAML and others to increase ocean science literacy that is widely recognized as a key to our nation's competitiveness, security and quality of life.

A. Taking Advantage of the NAML Network to Increase Educational and Training Opportunities for all Citizens

With approximately 100 laboratories in every coastal and Great Lakes state, and several foreign countries, and over 10,000 employees, NAML has an unsurpassed capability to reach the public, teachers, students, and decision makers. Although a national organization NAML is sub-divided into three regional groups (Northeast and Great Lakes, Southern, and Western associations) and thus provides a structure by which it is possible to develop and test the implementation of initiatives at various spatial scales. We believe that NOAA could take advantage of the capability of this network and use the expertise and experience of NAML laboratory scientists and staff to advance ocean literacy in multiple ways, ranging from improving the teaching of STEM subjects in formal education to advancing the public's general understanding of ocean issues. The coastal locations of individual NAML labs and the regional networks provide an ideal vehicle for program development, implementation and evaluation. The distribution of NAML labs at most coastal states allows them to interact with educators at the critical state level to ensure that teaching resources and lesson plans can be aligned with the state science education frameworks and standards.

Current educational initiatives at NAML labs are diverse, ranging from formal course offerings for undergraduate and graduate students, to programs directed at K-12 students and teachers, to more informal activities that involve the general public, citizen science programs and groups such as Elderhostel and Lifelong Learning. NAML labs are active participants and often host the regional competitions of the National Ocean Partnership Program-sponsored National Ocean Sciences Bowl. As mentioned above, NAML labs are also involved with COSEEs, the National Marine Educators Association and the National Science Teachers Association. Some of these programs and partnerships could serve as models or opportunities for increased NOAA-NAML interactions.

There are some obvious strong connections that can be made between current NOAA educational programs and NAML Labs that would be mutually beneficial. These interactions could be developed at local, regional and national scales with many NOAA programs that have established valuable educational components that together with the NOAA Office of Education make up an important set of activities designed to enhance overall ocean literacy. The following provides a listing of some of these education programs and ideas to better link these programs to the NAML network.

Sea Grant

As a national network of 32 programs representing over 300 universities and all coastal and Great Lakes states and several U.S. territories, Sea Grant already maintains ties to most of the NAML laboratories. As part of its education agenda, NAML will urge individual labs to seek out Sea Grant's university extension specialists, communication experts and educators to explore innovative mechanisms for collaboration.

Office of Ocean Education

- The Educational Partnership Program (EPP) in the Office of Education (OEd) is successfully addressing the CoOL report recommendation to link marine laboratories (federal research facilities) with minority serving institutions (MSIs) to help ensure that the ocean science workforce benefits from diverse backgrounds and perspectives. Through its Education and Diversity Committee, NAML offers to provide input and proposes to work more closely with OEd to expand such linkages across more marine labs and MSIs. This key strategy should be expanded (Gilligan et al. in press).
- OEd also supports the Ernest F. Hollings Undergraduate Scholar Program that supports students pursuing careers in science, engineering, policy, management or education. NAML proposes to work with NOAA's OEd to provide opportunities for placement of Hollings scholars at NAML labs.
- Finally the OEd sponsors an annual extramural Environmental Literacy Grants Program that supports educators to develop new methods and materials to increase ocean literacy in formal and informal learning settings. NAML's Committee on Public Policy strongly supports this and all of NOAA's extramural, competitive grant programs.

NOAA Education Council

NAML proposes to meet with NOAA's Education Counsel to identify the most appropriate NOAA Education programs to form real partnerships to meet our mutual education goals.

NOAA Field Programs and NAML Laboratories

There is considerable geographic co-location and proximity of NAML labs with many of NOAA's programs, including National Estuarine Research Reserve sites, National Marine Sanctuary Field Offices, National Marine Fisheries Science Centers and National Undersea Research Centers. NAML will urge these field stations to become active participants in NAML and to meet with NOAA program leaders to explore meaningful opportunities for collaboration.

Teacher at Sea Program

These at-sea opportunities currently are available on NOAA ships. NAML proposes to coordinate with NOAA's Office of Marine and Aviation Operations (OMAO) to possibly provide greater teacher at sea opportunities through lab-sponsored/implemented research cruises using laboratory and university research vessels.

Ocean Exploration and Research

NOAA's Ocean Exploration and Research (OER) program is the result of the administrative merger of the National Undersea Research Program (NURP) and the Office of Ocean Exploration (OE). Both programs have utilized the engaging nature of underwater exploration, technologies imagery and data to develop educational programs and products. NURP is implemented through a network of six regional Centers mostly located at state universities and many co-located at NAML labs, and have utilized their field locations to provide teacher research experiences, student hands-on activities, ocean observing education programs and live Webcasts featuring video from remotely operated vehicles and the Aquarius, the world's only underwater laboratory. OE has developed an award-winning website that features sponsored expeditions and highlights accompanying lesson plans that "Teach Ocean Science Through Ocean Exploration." NAML labs and the regional NURP Centers represent a natural partnership to develop teaching resources and provide learning and outreach opportunities.

B. Fund the Implementation of the Recommendations of the Conference on Ocean Literacy

In many ways the Conference on Ocean Literacy (CoOL) represented the culmination of years of evolution and recognition of the tremendous opportunities and challenges to meeting the goal of an ocean literate society. The recommendations set forth span the range of venues for ocean education from formal to informal and for learners from K to gray. To make headway towards ocean literacy will require tangible steps to implement the recommendations of the CoOL report. NAML proposes that NOAA support a workshop or series of workshops to prioritize and identify the most effective initiatives to implement the recommendations of the CoOL report and to determine how NAML scientists and educators can play a role in furthering these ideas. NAML is prepared to collaborate with NOAA and other relevant Federal entities to hold the workshop(s) and provide NOAA with a summary of the outcomes and recommendations from these workshops. We believe that the results of these workshops should help NOAA revise its education programming so that new competitive, merit-based extramural programs are developed that provide financial support for creative proposals that will implement the recommendations of the Conference on Ocean Literacy.

C. Provide Advice and Assistance on an Ongoing Basis

NAML members are also prepared to increase their participation by serving in both formal and informal advisory capacities to NOAA's Office of Education. A number of individual NAML members already serve on different federal ocean-related advisory groups, such as the Ocean Research and Resources Advisory Panel (ORRAP), the NOAA Science Advisory Board (and related working groups), etc. NAML has established a committee to provide recommendations and nominations of its members for such federal advisory committees and we encourage the NOAA Office of Education to use NAML's membership in whatever ways might be helpful for planning and execution of NOAA's ocean education programming. NAML's Public Policy Agenda strongly supports the extramural programs within NOAA, including the Office of Education's competitive grants program. NAML will also continue to invite members of

NOAA's leadership to attend its Biennial Meetings to foster the exchange of ideas and explore avenues for collaboration.

D. Participate in the Development and Review of NOAA's Education Plan

NAML is prepared to assist in the development and provide input on drafts of the new NOAA Education Plan, similar to suggestions made by NAML to the draft Ocean Research Priorities Plan, to assist NOAA in developing clear goals and metrics to measure the success of its education programs. We understand that NOAA has asked the National Research Council and its Board on Science Education to assemble a study committee to review NOAA's education programs. Through its EDC, NAML is prepared to assist that committee if invited.

V. Summary

This whitepaper has sought to highlight the evolution of U.S. ocean science education in the past decade, provide a snapshot of the investments made by NOAA in ocean science education, and exhibit the breadth of the educational infrastructure represented by the network of NAML laboratories. All of these represent a confluence of ideas and energy that together can be an agent for change to advance the goal of an ocean literate America. We are eager to offer the services of our Education and Diversity Committee to collaborate with the NOAA Education Office to explore the ideas presented above to identify the programs and strategies that would allow NAML Laboratories to become integral parts of the NOAA Education Mission. Following receipt and review of this document, members of NAML's EDC propose to meet with NOAA's Office of Education and other NOAA ocean science education leaders to develop a roadmap for moving forward.

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Appendix A - Members of NAML's NOAA Education Whitepaper Working Group

(* Education and Diversity Committee members, ** Chair of Committee)

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