

Foundations and Enduring Capacity of the National COSEE Network

Addressing the National Challenge

The National Science Foundation's (NSF) investment in COSEE was a carefully considered decision by the NSF Division of Ocean Sciences; it was based on considerable thought and input gathered at meetings and workshops from a broad spectrum of ocean science researchers and educators in the late 90's. This timely investment preceded the convening of the U. S. Commission on Ocean Policy (USCOP), the 2004 report of which stated that a nationally coordinated network for ocean sciences education was necessary. The report cited two national-level ocean education networks as having "particular importance" for the future: the National Centers for Ocean Sciences Education Excellence (COSEE) Network and the National Sea Grant College Program (NSGCP).

COSEE met the USCOP challenge of developing and implementing an innovative initiative to integrate ocean sciences research and education. This decadal review document will provide evidence that COSEE has been catalytic and successful at reaching its core mission of *engaging scientists and educators to transform ocean sciences education for all* by:

- Bringing current scientific research into education
- Actively engaging scientists in the education process
- Bringing the nature of science to educators
- Presenting the ocean in an Earth system perspective
- Engaging informal and formal education partners and public audiences in the ocean science enterprise to increase knowledge and understanding of the oceans.

Evaluation of COSEE's initiatives demonstrates that the National COSEE Network has provided ocean scientists with opportunities and tools to educate the public and assist in the preparation of our country's future workforce. This document will provide evidence that COSEE's first decade has built a strong foundation for future ocean sciences education endeavors that will embrace new technologies and advances in learning sciences to enhance the broader impacts of NSF's investments in ocean sciences research.

Since its establishment in 2002 as a set of 7 Regional Centers, COSEE has evolved into a coordinated Network. The Network is poised to respond to the current challenge: *Final Recommendations of the Interagency Ocean Policy Task Force* (2010) adopted by an Executive Order of President Obama when he established a National Policy for the Stewardship of the Ocean, Coasts, and Great Lakes on July 19, 2010. This Executive Order directs Federal agencies to take the appropriate steps to implement the recommendations. The NSF's COSEE program has established the infrastructure and reach to execute these recommendations for the U.S. by bringing the "relevance of the ocean sciences research to the lives of its citizens."

The Network's efforts have the potential to impact a more diverse workforce, supporting the tens of millions of jobs related to our coastal regions and territorial waters that contribute trillions of dollars to the national economy each year. An ocean literate workforce is required to fill positions in commerce, transportation, energy, food production, food safety, national security, and recreation/tourism. This workforce will support the country in addressing a wide range of

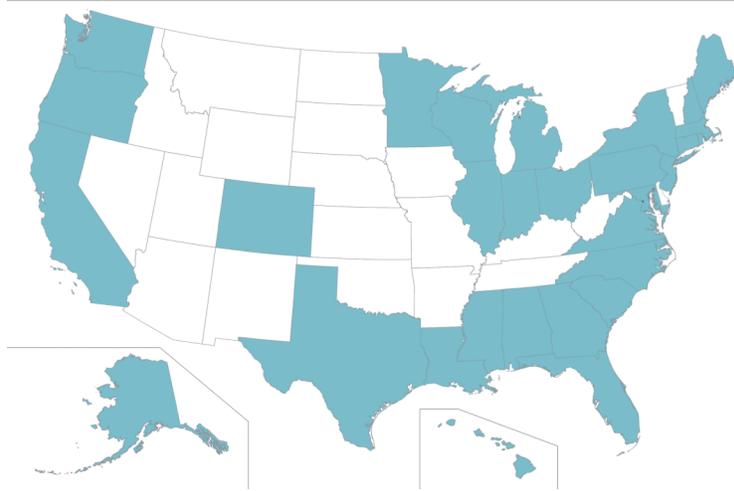
challenges, including more intense hurricanes, tsunamis, overfishing, pollution, and coastal development.

Return on the National Science Foundation Investment

This report makes the case that NSF's investment in COSEE over its first decade has yielded a significant return on that investment in the form of enduring programs and institutions that will continue to have a profound impact on ocean education far into the future. The entrepreneurship of the Network has leveraged NSF investments to include significant funding from other sources, in-kind contributions, and human capital.

The report documents COSEE's geographic reach, the impact of its programs, and the dissemination of its innovative methods. We can anticipate future high quality innovations and even broader dissemination as the reach of the Network extends into new regions of the country and as new international partnerships are established.

COSEE is comprised of over 270 institutional partners with close to two thousand Network members. We make the case that it has evolved into one of the country's most comprehensive ocean sciences education networks, with a direct reach into 30 states and an indirect reach across the U.S. and internationally.



States represented in the COSEE Network

The return on NSF's investment takes multiple forms, including the establishment of COSEE as a go-to community resource for ocean scientists to achieve broader impact goals, invention and propagation of innovative tools, development and dissemination of learning resources, strategies for broadening participation in ocean sciences, strategies to use ocean observatories data in formal and informal science education settings, blossoming of Communities of Practice, and application of new information and communication technologies.

COSEE's reach in these areas is documented throughout this report. Here we provide *single examples* of how NSF's investment is manifested, just to give the reader a feel for this reach.

COSEE has become a trusted community resource for achieving broader impact goals.

COSEE Mid-Atlantic and COSEE California led the production of *Education and Public Outreach: A Guide for Scientists* to help ocean scientists with strategies for satisfying their broader impact requirements. The guide is distributed to all Network university partners, at multiple national science society meetings, and to incoming faculty. Services of this type have helped ocean scientists effectively share the fruits of their research with a broader audience. In the case of COSEE California alone, over 200 scientists from 18 universities have used such services in proposal preparation.

Centers have developed innovative tools and shared them across the Network and beyond.

COSEE Ocean Systems developed a novel concept mapping tool in partnership with Raytheon Web Solutions. The team applied educational research on concept mapping to modify this educational tool for on-line use, so that scientists can deconstruct complex content to communicate their research to specific audiences. Numerous ocean scientists have been trained in its use, and it has proven to be exceedingly popular. This tool has now been used in the professional development of ocean scientists by most Centers and outside of the Network. For example, NASA's Jet Propulsion Laboratory is currently using this tool to train their staff.

Learning resources based on Ocean Literacy Principles have been created and disseminated.

COSEE California led a Network-wide initiative in partnership with the National Marine Educators Association, National Oceanic and Atmospheric Administration, National Geographic Society, and College of Exploration to develop a set of essential principles that every American should understand about the ocean. COSEE CA convened teams of ocean scientists and educators to develop a scope and sequence for these fundamental concepts as the framework for national ocean science literacy initiatives. The Ocean Literacy Campaign has influenced programs, curricula, textbooks, exhibits, and state and national science education standards. It has been the model for literacy principles for atmospheric, Earth, climate, and other disciplines.

COSEE has developed innovative strategies for broadening participation in ocean sciences.

The National COSEE Office initiated a Network partnership with the Society for the Advancement of Chicanos/Hispanics and Native Americans in Science to increase the visibility of ocean sciences at their annual meetings. COSEE, in partnership with SACNAS members, sponsors annual symposia and panels focused on ocean sciences research and career opportunities. This has proven an effective vehicle for exposing underrepresented undergraduate students to ocean sciences. Participation has grown from around a dozen students in 2008 to over 85 students in 2010. In 2011, COSEE will leverage NSF funds to broaden the reach of ocean sciences at the SACNAS meeting with additional funding from Scripps and Woods Hole.

Centers have pioneered the use of Ocean Observing Systems data in educational settings.

COSEE Networked Ocean World explored the use of real time data streams from coastal New Jersey in both research and education, and developed a series of innovative online tools that support the use of real time data in classrooms. This early work positioned COSEE to compete for NSF funding through the Ocean Observing Initiative (OOI). A team from COSEE Networked Ocean World and COSEE Ocean Systems was selected in 2011 to serve as the Education and Public Engagement (EPE) Implementing Organization for the OOI. The Network will benefit from new educational tools and products produced by the EPE team and the EPE OOI team will have ready access to a national dissemination Network.

Collaboration across the Network has led to the establishment of Communities of Practice.

COSEE has established small working groups to address key Network needs. Some groups have evolved to form communities of practice, groups of people who share a passion for what they do and learn to do it better as they interact regularly. For example, Center evaluators have gone from a loose aggregate of individuals contributing expertise to their individual Centers to a functional community of practice across the Network. The National COSEE Office has facilitated this development through annual evaluator workshops to address broad questions about the Network. Other working groups have evolved similar communities of practice. This unanticipated outcome of COSEE's funding has become one of the strengths of the Network.

COSEE has been riding the wave of new information and communications technologies.

Many Centers have used new software and technologies to broaden COSEE's reach through distance learning programs, virtual classrooms, webinars, on-line document development, podcasting, and social networking. COSEE West led the Network in delivering on-line, interactive professional development for educators. The new models have transformed professional development from the space- and cost-limited face-to-face mode to encompass groups of up to 450 educators across the country in an individual three-week program. The format has been evaluated and refined to increase participant gains. The National Oceanic and Atmospheric Administration is now supporting the proliferation of this model by using it in on-line professional development programs through their Office of Ocean Exploration and Research.

COSEE courses enhance communication of ocean sciences concepts and research.

The communication of ocean sciences has been a major initiative of COSEE since 2002. COSEE California developed a set of two innovative college courses: Communicating Ocean Science to K-12 Audiences (COS) and Communicating Ocean Science to Informal Audiences (COSIA), for which COSEE leveraged significant support from NSF's Informal Science Education program. These courses address critical needs to improve the ability of science faculty and researchers to communicate science concepts and research and provide science faculty and students experience using instructional materials that exemplify best practices in science teaching and learning theory. The course has been institutionalized at over 30 colleges and universities.

Capacity of the Network

The capacity COSEE has grown due to two primary drivers -- innovative and growing partnerships and the formation of the National COSEE Network. The 2002 NSF solicitation required Center partners of at least one each of ocean sciences research, formal science education, and informal science education institutions. This constellation of partners, retained in all subsequent COSEE solicitations, has contributed to a diverse community committed to ocean sciences education excellence. As the number of Centers has increased and the Centers have internally expanded, so have the number of partnerships. The growth has enabled the capacity of the Network to have increasing *depth* and a rich, diverse, and scholarly set of programs. The geographic, cultural, and discipline-related *breadth* of COSEE's partners increases the Network's capacity to reach into diverse communities.

COSEE's "excellence" is due in part to its diverse partnerships. A majority of the major oceanographic research centers, e.g., Woods Hole Oceanographic Institution, Scripps Institution

of Oceanography, University of Rhode Island Graduate School of Oceanography, University of Washington School of Oceanography, and Oregon State University College of Oceanic and Atmospheric Sciences are leaders in ocean sciences research and participate in the current Network.

The NOAA Sea Grant Network, Office of Education, and Office of Ocean Exploration and Research—Network members—provide additional access to a wider community of ocean scientists and to their extensive education and outreach capabilities. The partnership with the Smithsonian Institution’s Sant Ocean Hall resulted in the COSEE/Ocean Hall educator in residence at the museum, jointly funded by the Smithsonian Institution and NOAA.

The formation of the National COSEE Network, the second driver, increased the capacity of the individual Centers to make a coordinated impact on the ocean sciences education landscape. The Network has benefited from the development of a Strategic Business Plan and its associated Annual Operating Plans (AOP). The AOP provides a direction for the Network and documents progress on Network activities.

The Network, through its members, has emerged as a national leader in enhancing ocean literacy by engaging ocean sciences researchers with the education community. The Network has advanced ocean sciences by developing graduate and undergraduate courses in communicating ocean sciences that are now part of the formal course offerings at over 30 institutions nationwide. These courses help young scientists gain the tools to effectively communicate their research to non-scientific audiences.

The Network has a unified web presence (www.cosee.net) that provides extensive information on ocean related topics, educational resources for educators and the public, and information on opportunities to participate in online and in-person workshops at venues across the country.

Looking Toward COSEE’s Future

COSEE’s well-established partnerships with formal and informal education institutions will ensure that future advances and discoveries in ocean sciences research are efficiently integrated into K-16 education programs and instructional materials, as well as into public programming across the country. As the Network looks into its future, exciting opportunities are on the horizon. To serve NSF’s ocean scientists and ocean sciences education goals, COSEE is already focusing on NSF’s ocean sciences research portfolio, and has established alignment with major new NSF investments such as the Ocean Observing Initiative. It is also prepared to capitalize on the additions and technological enhancements to the oceanographic research fleet.

COSEE hosted a Community Meeting in November 2010 that was focused on the future of ocean sciences education and COSEE’s potential role. A discussion of how COSEE will meet the future challenges in ocean sciences education can be found in the next chapter.

COSEE will incorporate the products and results of broader NSF investments such as those emerging in cyberinfrastructure to provide new capabilities and tools with which the Network can reach educators, students, and the public. Research on science learning and teaching and new

research-based understandings of how to better serve diverse audiences will allow the Network to integrate ocean sciences research and education.

As a well-established NSF Ocean Sciences program with a strong foundation in the integration of research and education, COSEE will be a leader in future ocean sciences education efforts. The expertise, resources, and established infrastructure of the National COSEE Network will facilitate new and innovative approaches and facilitate national and international scale partnerships.

COSEE's enduring contributions include its impact on the people and institutions. Young ocean scientists, trained by COSEE institutions, will write better proposals, influence their peers, and communicate to the public. Educators, using COSEE's learning resources, will teach students about the ocean and the nature of science. COSEE's informal science institution partners will continue to use the connections to the ocean science community to provide the public with a rich understanding of how the ocean works and its importance to every individual—and indeed to life on Earth.