

**CENTER FOR OCEAN SCIENCES EDUCATION EXCELLENCE
CENTRAL GULF OF MEXICO (COSEE:CGOM)**

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PROJECT DESCRIPTION

PROJECT GOAL

The primary goal of this proposed regional COSEE—Gulf of Mexico effort is to strengthen ocean sciences education through the interpretation of research results for interested public, precollege teachers and their students, informal educators, and university and community college faculty and their students concerning the relevance of the oceans to our everyday lives. This COSEE is physically located within The University of Southern Mississippi (USM)-College of Marine Sciences' (COMS) J.L. Scott Marine Education Center and Aquarium (MEC&A) in Biloxi with satellite centers located within existing facilities in Alabama, Florida, Louisiana, and Texas. This project links educators, researchers, and interested public regionally and thematically, focusing on America's Sea, the Gulf of Mexico, as the vehicle to teach ocean sciences education.

BACKGROUND AND NEED

Over the last decade rich opportunities have

been missed by the ocean sciences community in not having a proactive, nationally coordinated educational program for the benefit of our country (Consortium of Oceanographic Research and Education) [CORE], 1996, Danzig and Daley, 1999; *COSEE Current* (NMEA, 2001); McManus, et al., 2000; Nowell, 2000; Walker, et al., 2000; and Walker, et al., 1992. It was also reported by Watkins (2000), "the exciting thing about the ocean is that its science is virtually *all* relevant to societal needs—quality of life, economic development, national security, education." Based on repeated acknowledgment of these missed opportunities, in May 2000, the National Science Foundation (NSF) provided fiscal support for a three-day COSEE Workshop—implemented by USM-COMS in Long Beach, Mississippi—involving 73 attendees representing 21 states and the District of Columbia. These participants included scientific researchers, K-16 teachers, information technology personnel, underrepresented groups, informal educators, and undergraduate students. The overarching goal of the May 2000 Workshop was "to create a document that recommends strategies for the NSF and other Federal agencies to use in a nationally

coordinated effort to improve and promote Ocean Sciences education in response to the opportunities by this workshop.” The Ocean Sciences (OCE) Division of the NSF proactively took the recommendations made by the attendees representing the ocean sciences community and developed an “Announcement of Opportunity” to which this proposal is responding.

This, COSEE:CGOM effort is a unique, thematic collaborative which is designed to deliver technology-enriched, ocean sciences education—based on “sound” science—to cadres of precollege teachers, undergraduate students, university and community college faculty, informal educators, underrepresented groups, and interested public. The authors of this effort submitted a regional effort based on the following rationale: the Gulf of Mexico is a small body of water as compared to the Atlantic and Pacific Oceans; however, the Gulf of Mexico is the drainage basin for the largest (Mississippi River) and the fourth largest (Mobile-Tensaw) river systems in North America. This basin drains two-thirds of the land mass of the continental United States. As reported in 1990 by the Environmental Protection Agency (EPA), the Gulf of Mexico is a national treasure deserving of our time, attention, and best stewardship efforts due to the following resources it provides:

- More finfish, shrimp, and shellfish than the South and Mid-Atlantic, Chesapeake, and New England Regions combined annually;
- a shrimp fishery which is among the most valuable U.S. fisheries;
- critical habitat for 75% of the migratory waterfowl traveling the U.S.;
- half of the national coastal wetlands’ total;
- one-sixth of the U.S. population lives in the Gulf Coast states; and
- 90% of the U.S. offshore oil and gas production.

There are three broad themes concerning the COSEE:CGOM in which this study will focus: habitats and organisms, oceanography and coastal processes, and marine technologies. These themes concerning the Gulf of Mexico and its bordering states will provide audiences an augmented appreciation and understanding of the relevance of the oceans to our everyday lives and the interconnectedness of all species on this watery

planet.

This COSEE:CGOM effort includes the following, primary partners: USM-COMS-MEC&A and the Mississippi-Alabama Sea Grant Consortium (MASGC); the University of Texas’ (UT) Marine Science Institute (MSI) in Port Aransas; the Dauphin Island Sea Lab (DISL) Research Consortium on Dauphin Island; the University of Florida (UF)/Florida Sea Grant College Program, the UF-Seahorse Key Marine Laboratory, the FL Department of Fish and Wildlife Conservation in Cedar Key, and the FL Museum of Natural History located on the UF campus in Gainesville; the Louisiana Universities Marine Consortium (LUMCON) in Cocodrie. Each of these facilities is affiliated with an Institution of Higher Learning and an informal science education center and each has a documented and successful history of working with the various audiences previously discussed. Other key partners include the U.S. Navy, specifically, the Naval Meteorology and Oceanography Command (NAVMETOCCOM) and the Naval Oceanographic Office (NAVOCEANO); the National Marine Educators Association (NMEA); the National Science Teachers Association (NSTA); the Center for Educational and Training Technology, the Digital Research and Imaging Laboratory of the School of Architecture and the NSF Engineering Research Center (NSF ERC) at Mississippi State University (MSU) in Starkville; the University of New Orleans (UNO) in LA; the College of Exploration in Potomac Falls, Virginia; and the Louisiana Public Broadcasting Station (LA-PBS) in Baton Rouge.

This COSEE:CGOM will enhance the ocean literacy of the citizenry by “bridging the gap” between researchers’ ocean sciences results and the interpretation and relevance of those data for all audiences represented by the general public. Further, this proposed effort will be a continued call to action in response to a litany of dismal status reports documenting lower-than-acceptable levels of U.S. student achievement and teacher preparation in technology and science—as reported in *A Nation at Risk* (1983), *Benchmarks* (1993), the *National Science Education Standards* [NSES], (1996); and *The Third International Mathematics and Science Study* [TIMSS] (NSTA, 1996 and

2000).

The understanding of and appreciation for technology and science, specifically the oceans, is critical for this nation's citizenry. The Pew Oceans Commission (2002) indicated the U.S. coasts are "more densely populated than the rest of the country with half the U.S. population living in the one-fifth of our land area along the coasts; by 2025, demographers anticipate three quarters of the U.S. population will reside in coastal regions." The National Sea Grant College Program (Walker, et al. 1992) reported that:

"Never before have scientific and global environmental issues influenced the actions of governments and individuals as they do today. Too few citizens, however, have an understanding of scientific principles and developing technologies—an understanding essential to help them make responsible decisions that affect their immediate environment and that influence governmental policies having global implications."

In October 2000, the Report of the President's Panel on Ocean Exploration was released entitled *Discovering Earth's Final Frontier: A U.S. Strategy For Ocean Exploration*. Among other characteristics of this strategic ocean science program recommended by the *Report*, "The Ocean Exploration Program should include an educational component that encompasses both formal and informal educational institutions as well as the general public. These efforts should incorporate existing programs and organizations that support marine and ocean sciences education" (p. 9).

The need for enhanced ocean sciences education is clearly recognized by the oceanographic community scientists, including classroom and informal education experts alike. A 1996 NSF-sponsored workshop—hosted by CORE—on ocean sciences and K-12 education found that "Oceanographic processes and features are ideally suited for constructing and demonstrating knowledge and science-based skills in the fundamental principles of science across the disciplines, including the social sciences, and over a wide range of levels of sophistication."

In the *1998 Year of the Ocean Discussion Papers*, an overview of the status of marine education stated that "nationally, preservice teaching and teacher credential programs rarely provide any special instruction in oceanography. Teaching methods courses frequently provide information about water, but rarely about the ocean specifically." Ocean and coastal studies offer abundant opportunities for relevant, exciting, and integrative technology and science education. In response to meeting the *NSES*, ocean and coastal science education are also largely untapped resources. Admiral (retired) James Watkins, former President of CORE, recognized that even though ocean sciences comprise "one perfect implementation mechanism to meet national standards," explicit references to the oceans are missing from the *NSES* (NOAA, 1998).

The *National Science Education Standards for Professional Development* (National Research Council, 1996) concluded that effective inservice education must include: the learning of science content through inquiry; the integration of science, learning pedagogy (teaching strategies), and demonstrating science relevance to students when teaching; and the building of science understanding and abilities for lifelong learning which are coherent and integrated.

Unfortunately, many elementary and middle school teachers are inadequately prepared to teach science in grades 5-9. As a result, many teachers choose not to attempt to teach science in their classrooms, ultimately resulting in less science being taught at this level nationally. A report funded by NSF (Horizon Research, Inc., 2002) found only 25% of elementary teachers perceived themselves as qualified to teach science. Further, less than 25% of these teachers spent more than four days in science-related professional development in the three years prior to this study. Finally, only one-third of the teachers participating in professional development "indicated that they changed their teaching practice as a result" (p. 2).

To address this serious concern, this COSEE:CGOM effort is providing a sequential set of professional development opportunities to both enhance and expand the content and pedagogical competence of middle school teachers (grades 5-9) through the study of ocean sciences. Further, this

effort is providing enhanced ocean sciences content knowledge for informal educators and the interested public in the Mississippi COSEE and the satellite COSEE facilities in each of the other Gulf states.

Additionally, the *COSEE Workshop Final Report* (McManus, et.al, 2000) and the *COSEE Implementation Steering Committee Report* (2001) both documented that improving diversity within the ocean sciences and creating a more scientifically literate citizenry requires that all educators, both formal and informal, be active participants. To best accomplish these goals most efficiently, outreach must occur in regions with higher proportions of underrepresented and underserved persons in science. Further, low economic status and traditionally undervalued educational systems have resulted in a population that generally does not have the capacity to understand the human impacts on the local environment. The Gulf Coast region contains significant proportions of populations considered to be underrepresented in ocean sciences and generally underserved by society. The U.S. Census Bureau (2002) data reveal the Gulf Coast states' minority populations consist primarily of two groups: Hispanics (outer portion: Texas and Florida) and African Americans (inner portion: Louisiana, Mississippi, and Alabama). As African Americans comprise the largest numbers of persons underrepresented in ocean sciences within this region, the following data are provided: these population groups are of relatively high densities along the coastal counties; importantly, a significant proportion of these demographic groups (> 30%) is under the age of 18; this result is consistent with U.S. Census Bureau projections that by the year 2020, the majority of high school-aged students will be comprised of persons from minority groups.

Impacting our population is the fact that the Gulf of Mexico states are among the most economically impoverished regions of the United States with poverty rates above the national average (U.S. Census, 2002). In particular, the state of Louisiana has the highest per capita rate of children born into poverty. The poverty in this region consists of two distinct populations: the rural and urban poor. In the states of Louisiana and

Mississippi, both populations live in proximity to the Mississippi Delta where poverty cuts across both ethnic and racial boundaries. Cities, such as New Orleans, have high concentrations of poverty as shown by the fact that > 65% of Orleans Parish school children are on free or reduced lunch (Louisiana Department of Education, 2000) and 40% of the children are born into poverty (U.S. Census, 2002).

Concerns by the U.S. Department of Commerce (2000) suggest a technological underclass is developing in this country. Unless proactive measures are taken to educate the underrepresented and underserved groups about their local environment, this lack of access to and use of technology will increase the numbers of underserved American citizens who will not have access to information necessary for a concerned citizenry. The partners of this effort believe if this situation continues, the population of U.S. citizens who will live their lives in poverty, with no hope for themselves and future generations will only increase.

The partners of this study cannot, nor do they seek to, solve all the social problems of the Gulf of Mexico region. However, through the creation of this collaborative, this COSEE:CGOM effort is allowing a positive impact on these populations. Currently, the combined efforts of these partners annually impact approximately 400,000 interested public; of this number, approximately 100,000 participants are represented by precollege students. Not all these students will become ocean scientists as adults; this is not the goal of this study. However, in a region with such low income, this COSEE:CGOM investigation will demonstrate to these students a future of possibilities. All of the partners in this study currently teach and will continue to teach all visiting students about their environment with integrated types of hands-on, inquiry-based learning that cannot be easily accomplished in the traditional classroom.

Finally, each site also provides added value to both students and the general public since these aquariums and natural history museums provide an important, and non-intimidating platform from which to engage the public in learning about ocean exploration, as well as demonstrating the influence

the ocean has on each person's quality of life (Schubel, 2001). Through their ongoing educational programs and exhibits, the Mississippi COSEE and satellite COSEE facilities will not only promote a better understanding of the ocean, but also the special characteristics of their specific region of the Gulf of Mexico. This increased understanding should lead to better stewardship of the ocean, the Gulf of Mexico, and ocean resources by those who visit the facilities and participate in their programs. Thomashow (1995) suggested that people are motivated to be environmental stewards not because of technical analyses regarding environmental degradation, but because they become aware of the place in which they live and the profound connection they have to this "place."

OBJECTIVES

This COSEE is physically located within USM-COMS-MEC&A in Biloxi, MS with state satellite centers within existing facilities in Florida, Alabama, Louisiana and Texas. Public exhibition and research laboratory space are being provided at the MEC&A for the COSEE scientist and educator, thereby allowing this regional COSEE to serve as a "window to the Gulf of Mexico" and to the oceans in general, so all the MEC&A guests can observe and interact with the scientist and educator concerning the oceans and near-shore environments. Specific objectives related to the stated goal of this COSEE include:

- To expand linkages between teachers, scientists, and partner organizations conducting ocean sciences research, education, and outreach through the COSEE in Mississippi and four state satellite centers within the Gulf of Mexico.
- To annually create professional development opportunities for up to 60 middle school teachers (grades 5-9) and up to 60 scientists through a fifteen-day Institute offered in each Gulf state and to provide and promote increased opportunities for the recruitment of minority students and teachers into ocean sciences education and research.
- To disseminate ocean sciences research results and complementary education materials and expand the linkages among informal educators,

researchers, and interested public.

- To provide "Teachers-To-Sea" opportunities for 42 middle school teachers annually aboard U.S. Navy Oceanographic Survey Ships (14 teachers on each of three different voyages).
- To enhance the numbers of minority students in ocean sciences research and education by providing 17 Internships annually.
- To assist school districts within the Gulf of Mexico region to align enhanced ocean sciences with district, state, and national standards.
- To create, coordinate and maintain an appropriate regional website which will be linked to all of the collaborators, as well as the Central Coordinating COSEE.
- To implement a program evaluation model regionally to provide assessment data and analyses to evaluate the effectiveness of the COSEE:CGOM to the COSEE:Central Coordinating Office (CCO) and the NSF.

IMPLEMENTATION APPROACH

To expand linkages between teachers, researchers, and partner organizations conducting ocean sciences research, education, and outreach through the COSEE in Mississippi and the four state satellite centers within the Gulf of Mexico.

The COSEE:CGOM is using the broad ocean sciences collaborations that exist within the five Gulf Coast states to reinforce learning for all age levels. By using existing ocean sciences research and educational facilities located in each of the five states, the collaborative intent of this COSEE will reach 120 "first tier" teachers (12/year/region x 2 years) and their 18,000 students (120 teachers x 150 students); the potential 2,400 "second-tier" teachers (120 x 20 teachers in staff development programs) and their 360,000 students (2,400 x 150 students each); 700 informal educators (350/year x 2 years); 34 undergraduate students (17/year x 2 years); and 800,000 interested public (80,000/5 Gulf of Mexico states x 2 years). The authors of this proposed effort are in the process of establishing a COSEE:CGOM Advisory Committee of 10-12 individuals to provide overall guidance and assessment for this

study; members of the COSEE:CGOM Advisory Committee will represent informal educators, precollege teachers, undergraduate students, interested public, university and community college faculty, precollege school administrators, underrepresented groups, the U.S. Navy, and information technology personnel.

Each of the satellite COSEE sites is providing opportunities to link ocean scientists, classroom teachers, formal and informal educators, and interested public through the use of the three, Gulf-wide content themes. It should be noted these three themes in oceanography and coastal processes were identified in 1993 by the Sea Grant Program faculty, the U.S. Navy, and the greater oceanographic community as the primary components for introductory education in ocean sciences (based on annual evaluations of these topics, they remain as precollege teaching priorities). These themes have been and will continue to be taught in an interdisciplinary manner, incorporating educational technology, 3D data visualization technologies, mathematics, social studies, and the humanities where appropriate.

- **Marine Technologies** - Discussions and presentations include the technologies involved in the discovery and exploration of hydrothermal vents, unique deep sea benthic communities, possibilities for ocean mining, offshore gas and oil deposits, and open ocean aquaculture. This theme is also providing an overview of the evolution and geography of the world's oceanic basins, theories of plate tectonics, continental drift, sea floor spreading, hot spots, methane hydrates, deep sea trenches, volcanism, and atolls using local and regional examples.

- **Marine and Aquatic Habitats and Organisms** - Nearshore and coastal habitats such as salt marshes, coral reefs mangrove swamps, barrier beaches, embayments, coastal lagoons, estuaries, and open water habitats, such as continental shelf environments, will be the habitat foci. Living organisms and their relationships to biotic and abiotic factors in their surrounding environments also represent the subject of this thematic component. The concept of sustainable

coastal zone environments utilizing the National Seashores/National Estuarine Research Reserve System (NERRS) programs and emerging technologies, to include aquaculture and sustainable fisheries will be used in this theme.

Oceanography and Coastal Processes - This theme is focusing on waves, wind action, currents, tides, substrate, water quality parameters, sea level rise, global change, El Niño, La Niña, coastal processes and natural coastal hazards such as erosion, hurricanes, flooding, and tornados. Presentations and activities also encompass sources of point and non-point pollution, harmful algal blooms, and environmental and man-made impacts.

The COSEE:CGOM facilities will each use state-of-the-art electronic technology for both teaching and communication activities. In addition to the traditional, field-based activities and virtual online conferences, enhanced education and training will also consist of an interactive online website that will link teachers and researchers across the region. New and expanded listservs have been developed to link teachers, researchers, and interested public. Chat rooms are being established for specific user interest groups for particular areas of ocean sciences interest. Real-time streaming of video and audio are providing expanded opportunities for users to participate in instructional activities as they occur from specific locations and asynchronously from the archived video and audio files on the media server. The planned streaming and other online technologies are providing access to information and instructional materials to anybody, anywhere, anytime. In addition to the streaming capabilities involved in this initiative, the capability exists to conduct interactive video conferences to connect presenters and the participants within the region for real-time, two-way interactive sessions.

Ongoing public outreach efforts at the USM-MEC&A—COSEE and the four, state satellite centers have been enhanced by the addition of a 100 percent Full-Time Equivalent (FTE) COSEE ocean sciences research scientist and an educator to be headquartered at the Mississippi COSEE and a 0.33 FTE educator at each of the other four, state satellite centers. The COSEE scientist will be taking the lead in public

outreach seminars and the dissemination of current research results Gulf-wide through the Mississippi COSEE website. This website will be linked to the EPA/MASGC “Research Results” websites. The resident COSEE educator is actively teaching, as well as coordinating teacher and public outreach efforts, as are the four part-time COSEE educators at the satellite facilities. Each satellite center has or is in the process of converting the 0.33 FTE COSEE educator funded at its site to a full-time educator through respective state funds and this educator is or will be responsible for coordination of teacher training, precollege student programs, and public outreach efforts, thereby promoting ocean sciences and COSEE, specifically within the Gulf of Mexico.

To create professional development opportunities for up to 60 middle school (grade 5-9) teachers and up to 60 scientists annually, through fifteen-days of COSEE Institute offered in each state, to include providing and promoting enhanced recruitment of minority students and teachers into ocean sciences education and research.

Annually, five, 15-day, Professional Development Institutes is addressing the latest ocean sciences research and educational methodologies and for up to 12 middle school teachers (grade 5-9) and 12 scientists in each state. The teachers and scientists work together in teams within their respective states. These Professional Development Institutes are being implemented for fifteen days; five days are being spent in each Gulf state for “hands-on,” inquiry-based, field activities, to include one of the five days and two to three nights being spent on power-point instruction; the remaining ten days are being implemented virtually through various forms of current and emerging electronic communications including, but not limited to, video conferencing. The PI and Co-PIs of each Institute are also providing ocean sciences educational materials to participants’ throughout the Gulf of Mexico region. Upon successful completion of the Institutes and follow-up activities—verified by the Co-PIs to the PI—the teacher participants will receive three hours of graduate credit through USM, the UF, the UT, the University of North Alabama, or the Louisiana State University. Teacher participants may choose

education or science credit to satisfy their respective professional needs. These 15-day Institutes may also confer Continuing Education Units (CEUs) if preferred by the participating teacher(s).

The virtual conference encompasses an equivalent time of ten days—over a six-week period—and involves the majority of the month of July and half of August each summer. The participating annual 60 Gulf-wide teachers are registering online and have been given their respective usernames and passwords for “logging on” in a timeframe they deem appropriate. The keynote presentations on the three themes previously discussed are primarily being provided by NSF, NOAA, Navy, EPA-funded, and/or academic ocean scientists and/or educators. Complementary assignments are being given which may require “up to” two hours per Keynote Presentation and online time does not normally exceed one-hour per day. The, COSEE:CGOM partners have determined the teachers have adequate computer and network access at home, a local library, or their respective school. It is also anticipated that in year two, this virtual conference will extend its registration as an option to the 350, two-day Informal Workshop participants should they wish to participate. The annual 60 precollege teachers are required to participate in this virtual conference as a component of their Institute commitment and subsequent receipt of credit.

Further, this virtual conference is being implemented using a variety of electronic communications technologies. These technologies include real-time synchronous interactive videoconferencing where practical—utilizing the H.320 video standards on closed networks, as well as the H.323 IP video standard across the World Wide Web and the Internet for the delivery of instruction, real-time, streaming video utilizing “Real Media” encoding for presentations from ocean sciences’ experts, asynchronous delivery of archived video and audio segments of presentations completed at an earlier time, web pages for delivery of static information, interactive CD-ROMs where high bandwidth is not available, chat room and listservs, telephone bridging systems, satellite uplinks and downlinks, and simple e-mail. The most appropriate combination of these current

and emerging technologies is being used to provide the best possible delivery of ocean sciences content, pedagogy, and instructional strategies and activities for up to 60 COSEE:CGOM teacher participants relative to the three ocean sciences research themes previously mentioned.

A five-member COSEE Selection Committee (one representative per state), including formal and informal educators and at least two members from Gulf coast NMEA chapters, ranked and selected applicants for participation in each of the 15-day Institutes. Participants were selected on the basis of the applicants' willingness to:

- Enroll in a three-semester hour graduate course and fully participate in the 15-day Professional Development Institute;
- Develop a minimum of one inservice teacher training staff development program within their respective schools or school districts;
- Infuse concepts and appropriate activities concerning ocean sciences within their classrooms; and
- Submit a journal article, present a paper, or demonstrate an activity at a state, regional or national education conference.

The following strategies are being employed by the PI and Co-PI in each of the state's Institutes:

- Presenting pertinent, experiential lectures by guest NSF, NOAA, Navy, EPA and/or academic scientists and science educators on three, Gulf-wide research themes through the 10-day virtual portion of the Institute;
- Involving the participants in field trips aboard research vessels to collect biological and oceanographic samples and data through the five-day residence portion of the Institute;
- Involving participants in field trips to marine-influenced habitats to study biota and associated resources through the five-day residence portion of the Institute;
- Developing communications and a sense of camaraderie among the community of learners, teachers, and scientists throughout each state and the Gulf region throughout the 15-day Institute; and
- Fostering the sense that technology and ocean sciences are exciting and relevant to every teacher's and student's life in and outside the

classroom.

The Gulf-wide, research themes and related primary curricular materials to be used at each state Institute were developed over the past eight years by teachers who participated in the successful Operation Pathfinder: Oceanography and Coastal Processes Institutes, funded cooperatively by NOAA, the Department of Interior, and the U. S. Navy; the Consortium for Oceanographic Activities for Students and Teachers (COAST), funded by the National Oceanographic Partnership Program (NOPP)/Office of Naval Research (ONR); and the Consortium for Oceanographic Activities for Students and Teachers: Putting Interactive Learning On Target (COAST:PILOT), funded by NOPP/ONR. The regional COSEE website includes the *Oceanography and Coastal Processes Resource Guide* which may be downloaded from the URL: <<http://www.coast-nopp.org/toc.html>>. Each of the 81 lessons in the *Resource Guide* involves a minimum of two hours implementation (it should be noted that these 81 activities were selected as the "best of the best" from a total of 1,441 activities which had been developed by teachers for teachers during the 1993-1997 Operation Pathfinder Institutes). This *Resource Guide* was aligned with the National Research Council (1996) approved *NSES* in 1999 by Dr. William Hall and his colleagues of the University of Delaware as part of the COAST effort. The *Guide* was then redesigned for delivery via CD-ROM and made interactive using NOAA and Navy (unclassified) data sets during the spring of 1999 by the Stimulating Teachers About Resources for Broad Oceanographic and Discovery (STARBOARD), the MSU component of COAST. The STARBOARD personnel further enriched this electronic *Resource Guide* by adding seven glossaries and career exploration data. It is important to also state that since February 2000, this *Resource Guide* receives an average of 518,000 "hits" and 106,000 page requests per month.

The COSEE:CGOM website is also providing linkages to prominent ocean science websites such as: the NOPP/ONR-funded BRIDGE at the Virginia Institute of Marine Sciences and the National Aeronautics and Space Administration (NASA) and NSF-funded Digital Library for Earth

Science Education (DLESE). The use of common themes provides a clear link between the five, Gulf-state professional development Institutes and outreach efforts. Each Institute is providing opportunities for participants to gain first-hand knowledge and experience with ocean sciences, field research methods and equipment, including oceanographic surveys aboard United States Navy Survey (USNS) ships. During the ten-day electronic communications portion of the Institutes, NSF/U.S. Navy/NOAA/EPA/Institutions of Higher Learning ocean scientists and educators are presenting projects and results which complement the three themes.

Additionally, 42 teachers each year (who have been previous participants in the 15-day Institutes) are being given the opportunity to participate in “Teachers-To-Sea” research opportunities and experiences through participation in the U.S. Navy’s NAVMETOCCOM and NAVOCEANO oceanographic survey cruises (14 participants each spring, summer and fall). The cruises average ten days, i.e. six to seven days at sea and three to four days being land-based to better understand the land/sea interface to include geography, heritage, and culture of the departure and return port cities, as well as visiting the NAVMETOCCOM facility at SSC, Mississippi. During these survey cruises, the teachers work “side-by-side” with Navy and/or civilian Navy scientists studying chemical, biological, and physical oceanography, to include but not limited to the following content areas: bathymetry, acoustics, bioluminescence, plankton, geodesy and mapping, conductivity, temperature, depth, geologic cores, and Naval applications of these data. The Naval ships previously used in COAST and currently being used in COAST:PILOT included/include the 329 ft. TAG-60 series of oceanographic survey ships: the *USNS BOWDITCH*, the *USNS HENSEN*, the *USNS SUMNER*, the *USNS PATHFINDER*, the *USNS HEEZEN*, and the *USNS MARY SEARS*. It should be noted the proposed “Teachers-To-Sea” component of this grant is modeling the Sea Scholars component of COAST and COAST:PILOT and was coordinated by St. Norbert College in DePere, Wisconsin <<http://voyager.snc.edu>>. The COSEE in Mississippi and the four, state satellite COSEEs are

using the five-member State Selection Committees to select cruise participants from the pool of COSEE teachers.

To disseminate existing ocean sciences research and education materials and expand the linkages among informal educators, researchers, and interested public.

In the fall of 2003 and 2004, each state will conduct an annual, two-day, Informal Workshop that brings together 70 informal educators and researchers to review ocean sciences research and educational activities within the respective states, explore future research and educational needs and collaborative efforts, as well as discuss the most effective methodologies for bringing this information to the interested public. Topical areas covered will encompass oceanography and coastal processes, marine technology, and marine and aquatic habitats and organisms.

Targeted audiences for attendance at this Informal Workshop will include representatives from institutions of higher education; research laboratories; informal educational institutions such as: aquariums, science centers, and museums; national and state professional associations; school districts; National Estuarine Research Reserves; National Estuary Programs; Coastal Ecosystem Learning Centers; State Education Agencies; National and State Fish and Wildlife Agencies; State Department of Natural Resources; National and State Park educators; environmental organizations; media; and interested public. Efforts will be made within each state to recruit minority representatives from institutions of higher learning, and from formal and informal organizations and agencies who serve largely minority audiences, to attend these Informal Workshops. The previously mentioned State Selection Committees will assist in the selection of individuals who will attend the state Informal Workshops.

Following these Informal Workshops, existing educational materials will be distributed through the participants’ respective communication and distribution networks, providing multiple points of access on ocean sciences to interested public. It is anticipated that new partnerships, synergistic activities, and collaborations among participants will result from these annual Informal

Workshops.

To enhance the numbers of minority students in ocean sciences research and education by providing 17 Internships annually.

It is anticipated beginning in the fall of 2003, a UNO consultant will recruit and provide candidates who will be interviewed by Navy representatives for each semester through the summer of 2005. It should be noted the UNO serves significant numbers of African-American and Hispanic students. The PI may also recruit undergraduate minority students from USM. Five candidates will be selected as Interns for the NAVMETOCCOM at SSC, Mississippi and/or the USM-COMS Department of Coastal Science (COA) with campuses at the MEC&A and the Gulf Coast Research Laboratory in Ocean Springs and/or the Department of Marine Sciences (MAR) at SSC. It is anticipated these students will be involved in ocean sciences research or education each semester. Annually, these 15 students will also be eligible to receive undergraduate credit and be paid at a GS-3 level by NAVMETOCCOM or NAVOCEANO. It is anticipated during the academic year, the students will go to class two days per week and work three days a week for either of these Navy facilities or within USM-COMS-COA or MAR. Also, as part of this undergraduate component, two, ten-week scholarships will be provided to minority students from the MS Gulf Coast Community College, one student from the Jefferson Davis Campus and one student from the Jackson County Campus. These two undergraduate students will be assigned to the Mississippi COSEE scientist and educator and earn undergraduate credit for their respective Internships. The summer Interns will have a different late May through early August schedule with their academic credit being earned in June and/or July.

To assist school districts within the Gulf of Mexico region to align enhanced ocean sciences with district, state, and national standards.

The PI and Co-PIs are cognizant of the respective state accountability plans as a result of the 2002 education legislation which requires that standards-based curricular activities and inquiry-directed instruction and training be implemented in

this nation's precollege classrooms. This unique collaborative will work with each Gulf of Mexico State Department of Education to ensure the instructional approach and materials complement the accountability needs of participating teachers and informal educators. Further, the COSEE:CGOM PI and each Co-PI will have direct access to their respective state science supervisors who will provide dissemination of program information and actively assist in the recruitment of participants using the state listservs, individual presentations, and the state department of education calendars. The PI and the Louisiana Public Broadcasting Station (LA-PBS) consultant have served as State Science Teachers Association presidents and are uniquely positioned to ensure communication between this COSEE:CGOM and the NSTA state chapters of all Gulf Coast states. This COSEE:CGOM in Mississippi and Louisiana will also be able to strategically use the NSTA Building a Presence (BaP) Program for science networking in each of the other three Gulf of Mexico states. This award-winning BaP Program is the largest networking initiative of NSTA and NSTA is also identifying a Point of Contact—an advocate for science—in every U.S. public and private school. Alabama, Florida, Louisiana and Texas are already states in the BaP Program and Mississippi is positioned to enter the program in 2003. The LA-PBS Consultant is the State Coordinator of the Louisiana BaP Program. As with all NSTA initiatives, one of the goals of the BaP Program is to put into practice local, state and *National Science Education Standards*. Using the BaP Program and the NSTA online system, this partnership will provide the COSEE:CGOM PI and Co-PIs a mechanism to distribute information into every K-12 school in their respective states. The PI and Co-PIs will continue to use the annual, state chapter conferences, listservs, and newsletters provided by each of the NMEA regional chapters and NSTA state chapters—in combination with other professional organizations—as a vehicle to recruit COSEE participants and to present materials and activities aligned to state accountability plans to help facilitate implementation of reform-based instruction.

The PI and Co-PIs anticipate working continuously with each state's PBS network to

create a flow of information concerning ocean sciences to educators, their students, and the general public. Public Broadcasting has long been identified with its efforts to ensure the delivery of quality programming to all citizens. Less known is the fact that educators—both formal and informal—identify the Instructional Television (ITV) programming made available by PBS as an important resource for information and presentation materials. Currently, teachers in several Gulf Coast states participate in the web-based PBS TeacherLine program where standards-based curricular materials are being delivered by the state affiliates in technology and mathematics. These stations are positioned to assist in the delivery of ocean sciences resources to schools and homes throughout the COSEE:CGOM.

To create, coordinate and maintain an appropriate regional website which will be linked to all of the collaborators, as well as the Central Coordinating COSEE.

The COSEE:CGOM at MSU is creating, developing, and maintaining a website which will accomplish the following three objectives:

- provide up-to-date informational materials and resources on ocean sciences;
- facilitate a communications structure linking the four groups listed below; and
 - 1) COSEE partnering collaborators;
 - 2) teacher and informal COSEE participants;
 - 3) undergraduate students and researchers; and
 - 4) interested public.
- facilitate the assessment and evaluation of the COSEE:CGOM by the Evaluation Team.

The COSEE:CGOM website will serve and is serving as a key resource that can be used by all partners and participants in the delivery of educational programs in their respective states. A regional listserv is being established to link researchers, educators, and interested public who are focused on and interested in ocean sciences issues and concerns. And, this website is and will be used as a communication link for updates, announcements, and pertinent information. The website is providing and will provide links to major ocean agencies, i.e. NOAA, NMFS, Sea Grant, NERRS, EPA, National Geographic Society (NGS), the U.S. Geological Survey (USGS), the U.S. Army Corps of Engineers, the NOPP/ONR-

funded BRIDGE, State Departments of Education, CORE, PBSs, participating Institutions of Higher Learning within the region, and DLESE.

To implement a regional evaluation model to provide assessment data and analyses to evaluate the effectiveness of the COSEE:CGOM to the COSEE:CCO and the NSF.

As previously cited, the project collaborators have significant accomplishments in implementing and evaluating science education programming within their states, regionally, and nationally. Drawing upon test instruments and evaluation surveys used in similar efforts, a team representing internal and external evaluators is administering or will administer pre- and posttests to all participants in the Professional Development Institutes Informal Workshops, , and the Teachers-To-Sea experiences to ascertain changes in content knowledge for the three ocean sciences themes incorporated in these programs. To gain a qualitative perspective, a Likert-scale type instrument with open-ended response items is being or will be used to monitor participants' attitudinal responses to all program components for use both formatively during the successive years of the effort, and summatively to develop annual and final reports of program accomplishments. Finally, all participants will be asked to complete post-program follow-up surveys at six-, twelve-, and eighteen-month intervals after participation. The surveys will solicit documentation from Institute and Workshop participants relative to the infusion of ocean sciences content and concepts into classroom and informal education settings, i.e. lesson plans, examples of students' work, and newspaper reports. Exemplary examples of these materials will be incorporated into the evaluation report and disseminated through an Online Portfolio of Participant Accomplishments. All of these data will assess the effectiveness of this COSEE:CGOM effort in sustaining changes in the content of formal and informal educational efforts of teachers with K-12 students at the "second-tier" level of participation and with the interested public through informal science education centers. Participants are completing or will complete all tests and surveys electronically via the regional COSEE website and individual passwords, with

results compiled and transmitted directly to the external evaluators to enhance the credibility of the results. Draft test and survey instruments have been included with the proposal supplementary documents; final versions of these instruments will be administered electronically.

DISSEMINATION AND COMMUNICATION OF RESULTS

To best achieve the intentions of the NSF in having all COSEE facilities be perceived as exemplary, model programs for comprehensive educational centers, it is important the results, accomplishments, and approaches of the regional COSEE be broadly disseminated to the ocean sciences education and research communities. To accomplish broad dissemination, the COSEE collaborators will undertake the following:

- Each year, the PI and Co-PIs, working with the internal and external evaluators and the COSEE:CGOM Advisory Panel, will develop an annual report assessing accomplishments and provide annotative data and support materials illustrative of the program's scope. This report will be linked to the regional COSEE website for public access. Further, the PI and Co-PIs will present the annual results in panel presentations at the national, annual conferences at NMEA, the Marine Technology Society (MTS), the American Geophysical Union/American Society of Limnology and Oceanography (AGU/ASLO), and the NSTA. The PI and Co-PIs are coordinating and will coordinate these presentations with the PI and Co-PIs of the other regional COSEEs to facilitate a systematic approach.
- Each year, the PI and Co-PIs will develop a "best practices" publication describing follow-up efforts of COSEE:CGOM 5-9 teachers and informal educators for dissemination nationally to provide guidance to other, similar outreach facilities and K-16 institutions. This document will be published by the regional state Sea Grant programs cooperatively, and disseminated through the Sea Grant Abstracts of Publications process already in place.
- The above described "best practices" document will also be linked to the regional COSEE website.

- The COSEE:CGOM Advisory Panel, will provide a series of public meetings in each regional state annually in year two and beyond for interested public, government officials, scientists, and educators. These meetings will update the various COSEE audiences on the status of the regional sites' activities, assessment, and planning procedures. Further, these public meetings will solicit and document public comments and concerns relative to the COSEE:CGOM and the three content themes, for use in summative planning efforts of "out year" activities, and with the annual and project evaluation reports.
- An informational exhibit will be developed for the COSEE:CGOM in Mississippi for dissemination of project information at regional and national conferences as delineated above, and at the states' annual science teacher and Academy of Sciences conferences. This exhibit will be made available to other ocean and environmental science agencies in the region to enhance public awareness and understanding of ocean science research and education, and to provide the public with communications information as a "clearinghouse" in the region. The PI and Co-PIs will emphasize the placement of this educational exhibit at trade conferences and symposia, comprehensive shopping malls, fairs and expositions (working cooperatively with advisory and extension personnel) and at state agency planning meetings.
- To provide for dissemination of regional COSEE activities and accomplishments to the public, the PI and Co-PIs are coordinating with the USM/COMS Public Information Office to implement public service announcements via print, and broadcast communications. Additional, extramural support may be required for this effort. Such support will be actively sought/identified by the PI and Co-PIs and in coordination with the PBS partnerships previously discussed.

ANTICIPATED ACCOMPLISHMENTS AND BENEFITS

This COSEE:CGOM study is ambitious and

requires a high degree of organization and networking which is being accomplished by the researchers and educators implementing this unique collaborative. This multi-dimensional partnership consists of institutions of higher learning, research laboratories, informal educational facilities (aquariums and one museum), national professional associations, state departments of education and their school and school districts, a PBS network, and the U.S. Navy. This COSEE:CGOM is achieving its goal in significantly enhancing ocean learning opportunities for all age levels (including adult and informal education) by infusing the results of ocean sciences into high-quality educational products and services and by providing opportunities for networking between these researchers and educators. The COSEE:CGOM in Mississippi and the satellite centers located in each of the other Gulf states will serve as individual “windows” to ideas, information, and resources that connect and celebrate ocean sciences teaching, learning, and scientific discovery at all levels.

It is anticipated the following accomplishments and benefits will accrue over the two-year grant implementation process of this COSEE:CGOM effort:

- Approximately 800,000 interested public will be positively affected relative to having an increased awareness and understanding of the relevance of the oceans to their everyday lives—resulting from visits to the Mississippi COSEE and the satellite facilities in TX, LA, AL, and FL (this figure is based on each facility annually impacting 80,000 interested public for two years);
- Seven hundred informal educators will have enriched ocean sciences knowledge based on presentations of current research results by scientists on one of the three themes at the Informal Workshops (70 participants x five sites x two years), thereby allowing these educators to better

meet the needs of their audiences within their agencies/organizations. The scientists, in turn, will have a greater appreciation for the expertise of these educators; this coordination should result in an enhanced mechanism for having interested public know more about scientists’ research results; Enhanced ocean sciences content knowledge and increased pedagogical skills by the 120 “first-tier” precollege teachers (60/year x two years) and 120 scientists (60/year x two years) who are enrolled in the five annual COSEE:CGOM Institutes with 84 of these same teachers also being selected to participate in the “Teachers-To-Sea” experiences with funding provided through the U.S. Navy. These 120 teachers have the potential of reaching 18,000 students (60 teachers x 150 students/teacher/year x 2 years);

- Twenty-four hundred “second-tier” teachers will be positively impacted through staff development programs conducted by each of the 120 “first-tier” teachers making a presentation to a minimum of 20 of their colleagues in their school or school districts. These 2,400 teachers have the potential of reaching 360,000 students (2,400 teachers x 150 students/teacher/year);
- Continued leveraging of the previously developed *Oceanography and Coastal Processes Resource Guide for Teachers* which was aligned with the NSES in 1999 for use by the teacher participants in this study. This *Resource Guide* has been receiving 518,000 “hits” and 106,000 page requests per month for the last two-years at its URL, <<http://www.coast-nopp.org/toc.html>>. This site also contains 700 related URLs, seven Glossaries, career information data, and visualization tools for teachers;
- Thirty-four undergraduate, minority students will have each spent one semester

working with the U.S. Navy scientists or USM-COMS ocean scientists or educators. The U.S. Navy will provide fiscal support for 30 Internships for these minority undergraduates and this grant will provide four Internships for minority, undergraduate students;

- “Win-win” partnership among the sponsors, i.e., academia, state and federal government, businesses, professional organizations, the private sector, and the interested public.
- the newly created, regional COSEE:CGOM website is linking ocean sciences researchers, educators, classroom teachers, formal and informal educators, and interested public;
- Evaluation and assessment analyses that will hopefully reveal significant, positive differences in pre- and posttest cognitive achievement scores by all Gulf-wide participants;
- Likert-scale attitudinal achievement analyses which will hopefully indicate all participants in the Informal Workshops and the Institutes have a rating of Very Valuable or Valuable concerning the content, presenters, activities, and field trips; and
- Concentrated efforts are being made by the Mississippi COSEE and its satellite facilities to serve as catalysts to connect underserved and underrepresented groups.

As previously stated, this COSEE:CGOM study is simply about one thing, our nation being prepared for the challenges of the 21st century. Further, the authors and partners of this effort are also cognizant that...as with most problems facing us today, there are no singular, simplistic solutions for ocean sciences education excellence; only carefully considered, multiple approaches will lead to incremental improvements for the next decade and beyond (Walker, et al., 1992). And, lastly, the implementation of this two-year, coordinated

and focused study will help empower our citizenry to make more responsible resource decisions relative to the interconnectedness of all species and our impact on the fragility of the global relationships of the oceans, the land, and the atmosphere (Walker, et al., 2001).

CAPABILITIES/PAST PERFORMANCE OF THE GULF OF MEXICO PARTNERS

As previously discussed, this two-year effort in the OCE Division of the NSF involves the five, primary regional COSEE-Gulf of Mexico institutions and facilities, i.e., USM/MEC&A, DISL/Estuarium, UF/Seahorse Key Marine Laboratory/Florida Museum of Natural History, UTMSI, and LUMCON/LA-PBS, MSU-ERC, the U.S. Navy, UNO, NMEA, and NSTA. These research, academic, outreach, military/government, and professional organization partners are ideally suited to—and experienced in—delivering programs of the highest caliber to interested public, precollege teachers and their students, as well as undergraduate students, underrepresented groups, and information technology personnel. The PI, the four Co-PIs, and the senior, non-Co-PI have documented success in forming partnerships which leverage resources to enhance and expand their respective research, educational, and outreach successes.

The USM-COMS-MEC&A in Biloxi, has received funding from the U.S. Navy, NOAA, the EPA, and the NSF and has been a regional and national leader in providing pre- and inservice opportunities for formal and informal science educators and for precollege students over the last 30 years. The COMS has two Departments and approximately 40 Ph.D. faculty with 75 graduate students who may receive Ph.D. or M.S. degrees in the COA or MAR Department. Graduate students may also receive M.S. degrees in the recently created and approved Hydrographic Science Center. The Gulf Coast Research Laboratory—Ocean Springs Campus currently

has over 62 affiliates throughout this country for its Summer School Program, which began in 1947. The MEC&A is the COMS' "Window to the Sea" and the MEC&A has an annual visitation of over 80,000 annual guests, of which 31,000 are precollege teachers and their students. Since 1993, the MEC&A has served as a JASON Primary Interactive Network Site (PINS) and the MEC&A has also hosted a regional National Ocean Sciences Bowl since that program's inception in 1998. Currently Drs. Sharon Walker, Alan Shiller, Marius Brower, and Vernon Asper, have active research proposals involving ocean sciences education, interannual variability in the Antarctic—Ross Sea, controls on seasonal variability of dissolved iron and manganese in rivers, and copper-specific metallothionein in blue crabs. Dr. Walker's areas of interest include teaching oceanography and coastal processes, coral reef ecology, and global climate change for pre- and inservice teachers. Dr. Walker has also been involved in precollege curriculum development on these same topics. She presently serves as Director for Education of MS-AL Sea Grant Consortium.

The DISL is a consortium of twenty-two colleges and universities in Alabama acting as the center for marine science research and education. The facility houses twelve Ph.D.s and forty full-time graduate students conducting marine research. Currently Drs. Jon Pennock, Monte Graham, and Richard Aronson have active NSF funding for research in nutrient loading, invasive species, coral reefs and Antarctic studies. For the past twenty-five years the DISL has offered marine education for grades K-12. Each year an average of 14,000 students participate in single and multiple day education programs. In 1998 the DISL constructed a public outreach aquarium, the Estuarium. This facility was designed to enhance the understanding of our oceans and near-shore coastal waters for the general

public. Approximately 80,000 people each year visit this facility. As a result of its marine education mission, the EPA's Coastal America program designated the Estuarium a Coastal Ecosystem Learning Center, one of fourteen in the nation. Dr. John Dindo received his degree as a research scientist specializing in hormonal interactions involving migration in fish and birds. He continues his research in this area, although at a reduced level due to chairing the Discovery Hall Programs, the Sea Lab's K-12 and public outreach programs. In 2000 Dr. Dindo received a grant from the National Fish and Wildlife Foundation to re-vegetate Cat Island, Alabama, following the damage done by Hurricane Georges. This island is the breeding site for 2,000 migratory herons and egrets. Dr. Dindo has also identified mid-shelf, hardbottom sites off the coast of Alabama and examined the fish fauna that inhabit these areas.

The UTMSI serves Texas as the premier marine research center for the northwest Gulf of Mexico coastline, and has received national funding from NSF, EPA, NOAA, Sea Grant and state funding from The General Land Office (GLO), Texas Parks and Wildlife (TPWD) and the Texas Natural Resources Conservation Commission (TNRCC). The UTMSI serves as the Department of Marine Science for The University, awarding Master's and Doctoral degrees to qualified candidates. For the past 27 years the Marine Education Services (MES) program—created and directed by Dr. Rick Tinnin—has hosted an average of 8,000 precollege students/year aboard research vessels where participants collect water samples, plankton, trawl and benthic samples. Over 600 precollege teachers/year participate through field-based inservice programs and institutes; the MES serves over 900 ELDERHOSTEL participants/year. Additionally the UTMSI Visitors Center hosts over 25,000 general public per year who participate in public outreach programs. Dr.

Tinnin has extensive experience in leading nationally and state recognized, inquiry-based, science education experiences for precollege and college teachers and their students, as well as for members of the general public through outreach efforts offered by the UTMSI Visitors Center and through 22 ELDERHOSTEL programs each year. Over 80% of MES program participants are either Hispanic minority students or teachers of minority students from throughout Texas. Dr. Tinnin has served on the NMEA Board since 1983.

The Florida Sea Grant Program (FSG), with administrative headquarters at the University of Florida (UF), in Gainesville, Florida is a State University System Center with a statewide mandate for marine science research and education. Fifteen core research and educational institutions (the 10 state public universities, three private universities and two marine laboratories participate in FSG activities. The FSG Extension Program (EP) has county-based faculty that have provided educational programs for the past 30 years to Florida's 11 million residents living in its coastal counties. The Florida Museum of Natural History (FMNH) is the official natural history museum of Florida. Powell Hall is the FMNH's 55,000-square-foot Education and Exhibition Center that houses exhibits and public education programs. During 1999, more than 116,000 people visited exhibits at Powell Hall; 35,000 K-12 students participated in museum educational programs. *Northwest Florida: Waterways and Wildlife* is a permanent 4,000 square foot exhibit that follows the path of water from Florida's environments to the Gulf of Mexico. Another 6,000 square foot exhibit *South Florida: People and Environments* recently opened and focuses on the Gulf of Mexico's estuaries and people of Southwest Florida. Dr. Mike Spranger is Assistant Extension Dean for Environmental and Natural Resources and Assistant Director for FSGEP at the UF. He

has over 25 years experience in the development and delivery of marine and coastal science programs for both formal and informal educators. His expertise is in the areas of marine policy, adult informal education and citizen involvement.

It is noteworthy to mention four of the five authors of this proposed, Regional COSEE—Gulf of Mexico effort have been NMEA Presidents, Dr. Rick Tinnin (1987-1988), Dr. Sharon Walker (1992-1993); Dr. John Dindo (1993-1994); and Dr. Mike Spranger (1995-1996). This fact demonstrates the perception of these individuals' leadership abilities and passion for ocean science education by this country's marine and aquatic education community. An additional strength of this collaboration is that the PI, Co-PIs, and the Senior, Non-PI are represented by two educators (Walker and Tinnin), two researchers (Dindo and Kastler), one marine affairs/policy partner (Spranger), and one Information Technology Collaborator (Brook).

Dr. Jessica Kastler assumed responsibility for LUMCON's education programs in 2000. She infuses her teaching with examples from her experience researching the role of mineral sediment in coastal environments—from their physical behavior in fluid flow to their geochemical role facilitating organic material storage in deposits below hypoxic waters. Dr. Kastler is increasing the impact of each student's experience by recruiting and facilitating researcher participation and developing web materials to enhance participants' LUMCON experience before and after their field trips. LUMCON is a partnership among nineteen universities developed to enhance marine science research and education. LUMCON employs seven scientific faculty members, four of whom currently receive support from the NSF in such areas as nutrient dynamics in hypoxic waters and bioturbated sediments and Gulf of Mexico iron cycling. The education programs address K-12, public and university

audiences to increase awareness and understanding of coastal marine threats and opportunities. Each year the program hosts approximately 3,500 precollege participants engaged in hands-on, inquiry-based field trips that last from one-half to seven days; approximately 100 teachers engaged in content enrichment and active teaching methods; and approximately 1,500 visitors view the public displays and aquariums. In addition, approximately 50 university students take a LUMCON, compressed-video class at their own university or spend a summer at LUMCON completing coursework or research.

Dr. Dan Brook is the Head of Computer Applications and Services and Co-Director of the Center for Educational and Training Technology (CETT) at MSU, in Starkville. He has over 33 years experience in developing and delivering technical training related to computer applications and over 15 years conducting research in the design and implementation of emerging advanced telecommunications network systems. His expertise is in the areas of advanced computer applications, networking, electronic classroom design, and interactive, virtual conferencing. MSU has a long history of working with the U.S. Navy and other agencies in the research and dissemination of advanced emerging computer-based technologies related to the ocean sciences. The CETT joined with the Digital Research and Imaging Laboratory of the School of Architecture and the NSF Engineering Research Center (NSF ERC) for Computational Field Simulation to build a foundation for transferring advanced 3D visualization technologies into K-12 classrooms. Internationally recognized work has been accomplished to apply state-of-the-art computational science and visualization tools to ocean sciences problems in partnership with NAVOCEANO for the last decade by the NSF ERC. As a “spin-off” of the NSF ERC research, new software has been developed to

bring 3D visualization tools to a level where they can be applied in the K-12 environment where it has never before been possible due to cost and hardware requirements. The focus of the former COAST and COAST:PILOT efforts have been to take non-classified software visualization tools and use them in the education and technical training environment to enhance the learning of complex concepts.

It should be noted this manuscript has been developed as a modification of the successful COSEE:CGOM proposal funded by the National Science Foundation-Ocean Sciences Division; the U.S. Navy-Office of Naval Research/National Oceanographic Partnership Program; and the National Oceanic and Atmospheric Administration-Office of the Oceanic & Atmospheric Research-National Sea Grant College Program.