2008

NOAA Ship *Okeanos Explorer*
Education Forum Report

NATIONAL OCEANIC AND ATMOSPHERIC ADMINISTRATION
OFFICE OF OCEAN EXPLORATION AND RESEARCH

NOAA SHIP *OKEANOS EXPLORER*
EDUCATION FORUM

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EXECUTIVE SUMMARY

The National Oceanic and Atmospheric Administration's (NOAA) Ship *Okeanos Explorer*, commissioned as the first Federal vessel dedicated solely to ocean exploration, will offer unparalleled opportunities to the scientific and education communities for "reaching out in new ways to stakeholders to improve the literacy of learners of all ages with respect to ocean issues" (Discovering Earth's Final Frontier: A U.S. Strategy for ocean Exploration, 2000[1]) and for enhancing awareness of Ocean Literacy Principle #7 – "The ocean is little explored." [2] Using a systematically mission-driven exploration protocol and advanced technological instrumentation and systems to explore little-known or unknown regions of the ocean, the ship will employ an integrated telepresence system that will provide broadband satellite transmission of data and discoveries in real time for science, education and outreach.

As a first step to achieving this vision, and in celebration of the commissioning, a two-day *Okeanos Explorer* Education Forum was held at the NOAA Pacific Marine Environmental Laboratory Western Regional Center Campus in Seattle, Washington, with the goal of developing the building blocks for a five–year education program. The Forum focused on how best to reach students, teachers, and other audiences in novel ways with the excitement of ocean exploration in light of the new assets and capabilities brought to the NOAA Ocean Exploration and Research Program (OER) by the *Okeanos Explorer.*

Along with advice provided through a series of guiding questions, Forum participants provided a number of short- and long-term product recommendations. These recommendations were prioritized by participants and the results are guiding the formation of the education programming for the *Okeanos Explorer*.

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FORUM INTRODUCTION

On August 13, 2008, the National Oceanic and Atmospheric Administration (NOAA) commissioned its new ship, the *Okeanos Explorer*, America's first ship dedicated to ocean exploration. In conjunction with this commissioning, the NOAA Office of Ocean Exploration and Research (OER), held a two day Education Forum at the NOAA Pacific Marine Environmental Laboratory Western Regional Center Campus in Seattle, Washington, with the goal of developing the building blocks for a 5-year education program plan for the ship. The overarching theme for this plan is to "Reach out <u>in new ways</u> to stakeholders to improve the literacy of learners of all ages with respect to ocean issues," and to enhance awareness of Ocean Literacy Essential Principle #7, "The ocean is largely unexplored." (See Appendix 1 for Meeting Agenda)

> ***Okeanos Explorer* Education Program Vision**
> *The NOAA Ship* Okeanos Explorer *is the ship upon which learners of all ages embark together on scientific voyages of exploration to poorly-known or unexplored areas of the global ocean. Learners will participate in innovative ways as ocean explorers in breakthrough discoveries that lead to increased scientific understanding and enhanced literacy about our ocean world.*

Education Forum participants in front of the NOAA Ship *Okeanos Explorer*.
Image: NOAA OER

OVERVIEW

Twenty-nine forum attendees represented a broad spectrum of the education and scientific community. They included Ocean Exploration's initial stakeholders who assisted in the development of the OE education program in 2001. Formal and informal educators, representatives from the OE Alliance partners (comprised of 15 public Aquariums and Universities) and those that work with underrepresented and underserved groups were present along with program evaluators. Those who work with real-time data in classrooms, web development and telepresence technology provided their expertise to the group. Additionally, an education researcher from the University of Washington provided excellent insight into the science of how people learn. (See Appendix 2 for full list of participants)

The two-day workshop began with an introduction to the NOAA OER program and a brainstorming session on what is meant by "in new ways" in relationship to ocean science education. The workshop continued with a series of plenary sessions designed to provide programmatic background and encourage the participants to think about future education programming for the *Okeanos Explorer* in creative and innovative ways. Plenary topics included: the Capabilities and Assets of the *Okeanos Explorer*, an overview of the Ocean Exploration Education Program, How People Learn with New Technologies, Virtual Learning Communities, Real-Time Data in the Classroom, and Bringing Real-Time Imagery to the Public. The afternoon of the first day, the participants were divided into working groups based on their expertise as described below (also see Appendix 3).

The second day of the workshop began with a tour of the ship in order to give participants a clear sense of its capabilities and to meet the staff and NOAA Corps officers on board. This was followed by more time in their working groups and large group discussions.

The two guiding principles for the Forum were 1) to continue the commitment of unfolding the fourth key objective in the President's Panel Report of "reaching out in new ways to stakeholders to improve the literacy of learners of all ages with respect to ocean issues" and 2) to enhance awareness of Ocean Literacy Essential Principle # 7 – "The ocean is largely unexplored." (Appendix 4 and http://www.coexploration.org/oceanliteracy/documents/OceanLitChart.pdf). Forum participants were asked to focus on how to most effectively capture and deliver the compelling and extraordinary ocean science content and real time exploration data the ship will collect, given the wide range of multimedia and other technological applications through which information might be delivered. Specifically, they were asked to frame their discussions within the construct of their working group's key audiences:

- Professional Development/Informal Education (K-12)
  Key audience defined as: K-12 teachers and informal educators.
- Formal Education (13-16)

Key audience defined as: Undergraduate [including community colleges, Minority Serving Institutions (MSIs)] and graduate faculty and graduate students; pre-service teachers and majors in science, engineering, or social science (archeology, economics, political sciences/policy); faculty trainers - those teaching faculty how to use data and information that can be provided from a ship of exploration; continuing education students (non-credit, adult learners); community college and 4-year institutions serving underrepresented/underserved (UR/US) audiences

- Underrepresented/Underserved Groups
Key audience defined as: Those that serve underrepresented/underserved populations
- Real-Time Data Use
Key audience defined as: Professional Development/Informal Ed (K-12), Formal Higher Education (13-16) and the Underrepresented/Underserved.
- New Media/Virtual Environments
Key audience defined as: Professional Development/Informal Ed (K-12), Formal Higher Education (13-16) and the Underrepresented/Underserved.

During breakout sessions, working groups were asked to discuss the following questions in relation to the education possibilities associated with the ship:

- What do the users in your area of expertise want to achieve?
- What are the users in your area of expertise prepared to receive?
- Are there partnerships/collaborations that are unique to unfolding any of these recommendations that you might suggest?
- What unique career or STEM opportunities reside within your area of expertise in relation to this effort?
- What might be some indicators of success for any or all of your recommendations?
- What short-term (two-year) products/services do you recommend OER develop/offer?
- What long-term (5-year) products/services do you recommend OER develop/offer?

Over the course of the workshop, working groups discussed these questions in a series of breakout sessions, followed by group reporting and large group discussions. On day two, each group provided their comments and recommendations. Additional participant comments were captured by staff throughout the workshop (Appendix 5).

Lastly, participants were introduced to the Ocean Literacy Essential Principles and Fundamental Concepts, specifically Principle Seven, **The ocean is largely unexplored** (Appendix 4). All groups were asked to review this principle's associated Fundamental Concepts to identify unique programmatic capabilities for addressing them. The results of this discussion are on page 23.

In addition to a review and comment period for preliminary outcomes of the Forum, participants were specifically presented with the compiled results of the last two questions: *What short-term (two-year) products/services do you recommend OER develop/offer? and What long-term (5-year) products/services do you recommend OER develop/offer?* They were asked to individually rank the recommendations in order of priority 1-3, 1 being of highest priority. Tallied results begin on page 14.

RESULTS FOR EACH QUESTION BY WORKING GROUP

WHAT DO THE USERS IN YOUR AREA OF EXPERTISE WANT TO ACHIEVE?

Working Group: Professional Development/Informal Education (K-12)

The professional development and informal education working group indicated that K-12 teachers and informal educators were prepared to achieve a higher level of content knowledge, to enhance their instructional pedagogy, and to increase their technological skills. This group stated that formal and informal centers, such as the NOAA Ocean Exploration Alliance Partner sites, are prepared to utilize new material to enhance exhibit design for the general public and to increase their own content knowledge.

Working Group: Formal Education (13-16)

The formal education working group indicated that undergraduate and graduate faculty are looking to invigorate their course content with current, relevant, topical research and undergraduate and graduate students are seeking engagement with scientists and opportunities to see authentic science in action, realistic career information, and opportunities to be part of a peer based science learning community. This group also indicated that continuing education students are looking to brush up on their current knowledge and pursue topics they didn't explore in their earlier academics or professions.

Working Group: Underrepresented/Underserved Groups (UR/US)

The underrepresented/underserved working group indicated that this audience strives to increase success (literacy, recruitment and retention) through access, exposure and inclusion in ocean science opportunities. They emphasized the need for multiple forms of support for the UR/US populations, i.e. engagement, capacity building and continuity via mentorships, and networking. They further emphasized the need for purposeful connections with the UR/US communities and presenting information in a "real world" context. The parents of UR/US students desire access to higher level, more significant opportunities than they had as children. UR/US students need a better understanding of their world and their place in it and they need to know how they can make a contribution to improve their world and quality of life.

They further indicated that those that serve UR/US population strive to highlight and showcase the work of diverse young people who have a personal connection and commitment to ocean exploration.

This group also expressed the need for NOAA OER to have a strong investment and dedication to the UR/US audience and that any *Okeanos Explorer* staff working with such individuals/groups have the information, assistance, support and skill development necessary to build a nurturing environment for success.

<u>Working Group: Real-Time Data Use</u>

Those participating in the Forum and targeting use of real-time data indicated all user groups (as defined above) seek access to usable sets of non-proprietary, current, scientifically- rich and interesting data. They want to apply data and information to better understand, investigate and perhaps solve today's environmental problems.

Recommendations included creating other products that can be shared when true real-time data are not available and leveraging youth's significant experience with digital media to increase excitement in ocean exploration and discovery.

<u>Working Group: New Media/Virtual Environments</u>

Those participating in the Forum and targeting use of new media and virtual environments indicated all user groups (as defined above) seek easy access to authentic science and scientists. These users want to "discover for themselves" the importance of ocean exploration through self-selected technologies such as RSS feeds, You-Tube, and Twitter.

WHAT ARE THE USERS IN YOUR AREA OF EXPERTISE PREPARED TO RECEIVE?

<u>Working Group: Professional Development/Informal Education (K-12)</u>

The K-12 professional development and informal education working group indicated that formal classroom teachers are prepared to receive well-developed, pre-packaged downloadable materials aligned with state and national science standards and Ocean Literacy Essential Principles and Fundamental Concepts (http://www.coexploration.org/oceanliteracy/documents/OceanLitChart.pdf). Additionally, they rely on free access to high-quality information shared in a way that is easily accessible. It was pointed out that information providers should not rely solely on internet access for all members of this user group.

This group further shared that educators at informal science centers are prepared to receive access to scientists and other experts in the field of ocean science and current, accurate content they can share with their audiences.

Working Group: Formal Education (13-16)

The formal education working group stated that undergraduate faculty are prepared to receive online resources but would need content on telepresence and that faculty at community colleges are much more familiar and comfortable with video-telecommunication programming and distance learning. They further indicated that many two-year and four-year college faculty are not well informed in the use of real-time data in their classrooms but are prepared to learn new pedagogical techniques as part of pre-tenure professional development.

With regard to undergraduate and graduate students, this working group agreed that college students are well prepared and proficient with all the latest communication technologies, are receptive and attracted to multi-disciplinary approaches to learning and to virtual experiences, and are very engaged in social networking. These students are also well-prepared to actively participate in ocean science-oriented competitions (e.g., ROV and submarine building) and are interested in information on current career options.

Working Group: Underrepresented/Underserved Groups (UR/US)

According to this working group, some UR/US populations are prepared to receive marine science education via the use of technology and others are not. It is important to remember that many UR/US households have limited or no access to computer technology. For this reason, it may be more suitable to reach this audience via popular television or radio stations. This group emphasized the need for broad, equitable access to information.

Further, it was stated that UR/US audiences are interested in connecting with role models and ambassadors. Role models in all aspects of ocean science from all UR/US populations are essential to capturing this audience. The group recommended that NOAA and the *Okeanos Explorer* work toward diverse representation of associated personnel by way of connections with the Minorities Striving and Pursuing Higher Degrees of Success in Earth System Science Program (MS PhD), the American Society of Limnology and Oceanography's (ASLO's) Multicultural Program and other programs that have demonstrated success recruiting, retaining, and supporting US/UR students in STEM fields.

Working Group: Real-Time Data Use

With regard to the use of real-time data, this working group indicated all represented user groups are interested in engaging new images of the ocean and unfamiliar images of ocean life and habitats and compelling visualizations of data, all put into proper contexts (e.g., scientific and historical importance) All user groups are also very interested in how they can take action to help the environment. This working group pointed out that we need to show/tell users how they might help. For example, these users could be guided in the process of looking through the data themselves to help solve environmental problems or to identify potential discoveries (i.e. find new species, interesting rock

formations, etc. in video feeds). For most users, manipulating data is more exciting and rewarding if there is the potential for this activity to actually contribute toward some goal.

This group noted that while the "real-time" capability is very important to the exploration process, it is much less important to education. The real-time aspect could be simulated to convey a realistic understanding of the actual exploration process. This also addresses the obvious constraints involved in trying to synchronize a real-time data stream with class schedules.

This group also pointed out that all users are prepared for data presented via low bandwidth with easily understandable "friendly" data visualizations. These representations of data should be tested and can be available 24/7. Users will be most receptive to education materials that tell a story or set the context to understand or use the data.

Working Group: New Media/Virtual Environments

The New Media/Virtual Environments working group indicated that there is no easily accessible data on what the identified user groups are prepared to receive in this context. They suggested surveying the population to determine what they are able to access. They further suggested that the best way to deliver products to the K-12 audience may be via either a DVD or television given that Flash video and You-Tube are blocked by many schools and education organizations.

ARE THERE PARTNERSHIPS/COLLABORATIONS THAT ARE UNIQUE TO UNFOLDING ANY OF THESE RECOMMENDATIONS THAT YOU MIGHT SUGGEST?

Working Group: Professional Development/Informal Education (K-12)

The K-12 Professional Development and Informal Education group recommended partnerships with academic institutions, The College of Exploration (TCOE), The Center for Online Professional Development's (EDC), EdTech Leaders Online (ETLO) program, and the North American Association for Environmental Education (NAAEE). Through these partnerships courses, workshops and seminars can be offered for optional credit - either graduate credit in science or science education or for professional development units.

This group further recommended considering unfolding various education recommendations from the Forum via public television programming for school systems and exposing the public to *Okeanos Explorer* education products through collaboration with the Smithsonian Museum of Natural History's Sant Ocean Hall.

Given the planned use of high-tech cameras and remotely operated vehicles, this group particularly emphasized interest in collaboration with film schools to engage film students in work with ocean exploration technology, thus feeding the STEM pipeline.

Lastly, this group recommended partnership with the National Ocean Sciences Bowl (NOSB) as an avenue for inspiring talented high school students and their teachers/coaches in new areas of marine science.

<u>Working Group: Formal Education (13-16)</u>

Within the community of university faculty, graduate students, faculty trainers and community college instructors and students, this group recommended utilizing the Marine Advanced Technology Education (MATE) Center to communicate with their partnering community colleges; working with the Centers for Ocean Sciences Education Excellence (COSEE) Network, the National Association of Marine Laboratories (NAML), the Consortium for Ocean Leadership, and other appropriate professional networks to market NOAA OER products to the faculty from community colleges and 4-year institutions, including minority serving institutions and; presenting to community college and undergraduate school faculty through the conferences of a broad range of professional organizations (e.g. American Association of Physics Teachers, American Association Community Colleges, National Association of Biology Teachers (NABT) , Society for the Advancement of Chicanos and Native Americans in Science(SACNAS), American Indian Science and Engineering Society (AISES), and the NOAA Cooperative Science Centers annual forum). This group also emphasized the NSF GK-12 program as a network suitable for collaboration and increased use of OE resources and encouraged presenting at an annual G-K12 PI conference hosted by the National Science Foundation.

With regards to direct professional development, this group suggested creating a one-day Ocean Exploration workshop in cooperation with college science faculty and presenting it at a National Science Teachers Association conference. They also recommended inviting members of the Marine Technology Society (MTS) to serve as speakers in podcasts and other products related to relevant careers.

Considering publications, this working group recommended producing articles for the Journal of College Science Teaching, the Journal of Geoscience Education, American Biology Teacher [a publication of the NABT] and other professional society journals beyond those specifically targeting marine education/oceanography. From the textbook perspective, they suggested pursuing the incorporation of Ocean Exploration and the *Okeanos Explorer* into future editions of popularly used Oceanography and marine science texts such as Invitation to Oceanography and Life on an Ocean Planet. Additionally, they mentioned exploring partnership with the American Meteorological Society's (AMS) publishing group and their program Online Ocean Studies. They further recommended feeding stories to the Association of Science Writers and the Society of Environmental Journalists.

Of course, leveraging products developed via the NOAA OE Alliance network partnerships for use with Community Colleges and higher education institutions was also encouraged.

Working Group: Underrepresented/Underserved Groups (UR/US)

This group again emphasized their recommendation of partnership with the Minorities Striving and Pursuing Higher Degrees of Success in Earth System Science Program (MS PhD) in order to recruit well-prepared, diverse staff for work in NOAA and on the *Okeanos Explorer*. The thought from this group is that this particular partnership will provide an avenue to jumpstart engagement of US/UR populations in current NOAA OER efforts; it will minimizes time NOAA staff might need to spend identifying, recruiting, and engaging undergraduate and graduate students and; it establishes partnership with an organization with proven success in these endeavors. This type of partnership would develop a model for outreach and meaningful engagement that could be expanded, over time, to include similar US/UR organization and groups.

This group stressed the need for NOAA OER to initiate and strengthen its partnerships with Minority Serving Institutions nationwide. This partnership could include orientation and placement of remote Exploration Command Centers on select coastal and interior campuses of Tribal Colleges, Hispanic Serving Institutions and Historically Black Colleges and Universities.

Lastly, this working group suggested reaching out to technology, engineering and physical science-based groups beyond those regularly targeted by marine science and education programs.

Working Group: Real-Time Data Use

This group recommended that NOAA OER and the *Okeanos Explorer* education team establish connections with visualization experts, such as the Institute of Electrical and Electronics Engineers Information Visualization Conference (IEEE InfoVis), to develop better ways to present information for different audiences, noting that visualization laboratories need to develop standardized methods for depicting data that would be easily recognized by the general users (i.e. consistency in false color mapping).

The Real-time Data Use working group emphasized the need for scientists to work with educators to better understand the ways people learn, utilizing pedagogical experts to determine the most effective ways to present data and ocean exploration science to different audiences. They further suggested partnership with media specialists to best share the work and products of the *Okeanos Explorer* with the general public.

Working Group: New Media/Virtual Environments

The New Media/Virtual Environments group provided the following list as suggested partnership avenues:

- Google Maps/Earth/Ocean
- YouTube
- Discovery Channel
- History Channel
- NOAA TV
- National Geographic
- Smithsonian Institution Museum of Natural History's Sant Ocean Hall

- Linden Labs and SciLands
- Apple Computers
- Center's for Ocean Science Education Excellence (COSEE)
- National Marine Educators Association (NMEA)
- The College of Exploration

WHAT UNIQUE CAREER OR STEM OPPORTUNITIES RESIDE WITHIN YOUR AREA OF EXPERTISE IN RELATION TO THIS EFFORT?

Working Group: Professional Development/Informal Education (K-12)

The Professional Development and Informal Education working group saw unique science, technology, education and mathematics education opportunities and unique career opportunities in a number of arenas. This group emphasized the need to share the more unfamiliar or unexpected STEM professions aboard a science research or exploration vessel with K-12 teachers and informal educators. These career paths include electronic/electrical engineering; computer science; mechanical engineering/marine engineers; satellite communications; cartography; acoustics and; professional science communication (writers, photographers, videographers, radio producers).They also mentioned careers as medical officers and boat captains on high-tech ships.

This group pointed out how important it is for students to understand that life on a ship requires significant skills in teamwork and a strong social and moral character. In this vein, *Okeanos Explorer* ship crew can serve as excellent role models for young people.

This group also emphasized the potential to work with post-production companies seeking talented filmmakers and videographers. NOAA OER could pair students up with such companies for job shadowing and internships, in another effort to feed the STEM pipeline.

Working Group: Formal Education (13-16)

The formal education group equally saw a huge opportunity to promote a wide variety of careers related to ocean exploration in:

Natural sciences	Engineering (mechanical and electrical)
Marine archaeology	Remote sensing technology
Marine affairs/policy	Film/Photography/Videography
Marine operations navigators	Educators
Marine technology	Outreach professionals
Ocean engineering	Naval architecture

Computer technology & computer engineering   Cartographers
Data management   Satellite engineering

Working Group: Underrepresented/Underserved Groups (UR/US)

In response to this question regarding unique career or STEM opportunities, the UR/US group had similar thoughts to Groups 1 and 2 re: the *Okeanos Explorer* being a powerful source of information and a vehicle for heightening awareness and bringing information to communities and students at all levels of schooling about the amazing array of jobs and opportunities in this field. They noted that the work of this ship has the capability to broaden the horizons of students at all levels and those of their associated adults (parents, teachers, guidance counselors, community leaders, and faculty). It has the potential to raise their awareness of the full and diverse range of career options, highlighting all aspects and disciplines related to marine sciences, and, equally highlighting the array of highly technical specialties (some of which may not require traditional college STEM preparation) as well as those in non-scientific and non-technical areas such as communications, policy, and education.

It was this group's opinion that every expedition, every encounter with the *Okeanos Explorer*, and every associated education product developed, should have a STEM and career component where the life stories of crew, technicians and scientists can be told, where the details of life onboard the ship and life of the supporting team onshore can be elaborated, and where students have an opportunity to ask questions of all participants. They further stated that the crew, technicians, scientists, and support teams should understand they serve a critical function as role models, view this "career education" task as one of their duties, and be prepared/trained as necessary to fulfill this role effectively.

Working Group: Real-Time Data Use

The Real-time Data group expanded the list of potential career/STEM avenues to include science translators, data visualization experts, artists, data aesthetics and scientists who either work in multiple scientific disciplines or mix marine science with another area of expertise such as art, film or computer technology.

Working Group: New Media/Virtual Environments

The New Media/Virtual Environments group noted that the rising interest of young people in computer and gaming technology highlights an interesting potential career option associated with marine science and ocean exploration.

This group also pointed out that New Media (defined as access to content on-demand through use of a digital device, as well as interactive community development and participation around media content) is an opportunity for STEM education and learning integration in today's classrooms. Students could become STEM reporters, reporting on activities happening aboard the ship, or develop exploration

projects that could become a part of an expedition, or some sort of STEM competition could be developed in association with the *Okeanos Explorer* expeditions.

WHAT MIGHT BE SOME INDICATORS OF SUCCESS FOR ANY OR ALL OF YOUR RECOMMENDATIONS?

Working Group: Professional Development/Informal Education (K-12)

In considering indicators of success for their recommendations the professional development and informal education working group provided the following suggestions: Track the number of people downloading activities; track the number of hits for any data products provided online; incorporate pre and post surveys for all programming participants; execute a "confirmation evaluation" (e.g. surveys, interview, phone calls) in order to determine amount of use of products and services over time; evaluate acceptance level of curricula and materials by county, district and/or state science education entities; evaluate level of product use by current and future OE Alliance partners (e.g. exhibits, programs, speakers, remote consoles).

This group also emphatically pointed out that implementation of these efforts would demand additional staffing for the NOAA OER education team.

Working Group: Formal Education (13-16)

The Formal Education group identified one indicator of success for their audience as established evidence that faculty have joined & continue to use the OE online learning community. They suggested measuring how faculty use the online information provided, what collaborations are built as a result and, generally, how they benefit from their involvement with NOAA OER.

Similar to the K-12 group, the formal education team discussed measuring distribution and use of various products (e.g. number of web downloads, number of users, etc.) They further suggested tracking the number or presentations done for "new" professional audiences, other than the standard audiences to which we present annually or biannually, as well as tracking the number of published articles in "new" professional journals or in primarily research focused publications such as Oceanography magazine.

They also mentioned the importance of determining how these products are used and the perceived impact by groups of users, specifically mentioning tracking the number of remote consoles at Community College and undergraduate institutions (esp. at MSIs and smaller underserved institutions); the number of institutions offering an Ocean Explorer course to undergraduates or graduate students

and; the number of applications for internship programs & the number of individuals placed in these programs.

Working Group: Underrepresented/Underserved Groups (UR/US)

The UR/US group had a number of specific points regarding indicators of programmatic success in terms of this audience and divided these indicators into four categories: general indicators, communication indicators, partnership indicators and participation and learning indicators. A general indicator would track the fiscal resources used to pursue the involvement of UR/US groups in *Okeanos Explorer* activities. It was suggested that, as programs focused on UR/US groups are launched (via the short and long term product recommendations), specific indicators of success follow directly.

Analyzing efforts toward communicating the professional, educational, and personal possibilities represented by the *Okeanos Explorer* to UR/US groups is considered a Communication Indicator. Communication Indicators should involve examination of:

- how information about the ship and the OER program is provided to UR/US groups and communities
- how that information continues to spread beyond those initial points of contact
- how UR/US communities access *Okeanos Explorer* and OER education resources

It was further suggested that OER disseminate information and cultivate involvement through non-traditional print and broadcast media (e.g., cultural and ethnic newspapers, radio and TV stations) in order to reach unique groups that can be difficult to reach otherwise. In order to be successful, this will necessarily involve developing strategies for communicating ship activities in the primary languages of these diverse communities to the degree possible.

Analysis of progress in establishing working partnerships with organizations that are allied to the *Okeanos Explorer*/OER mission results is a Partnership Indicator. A Partnership Indicator should involve an examination of:

- how progress on the *Okeanos Explorer*/OER mission is accomplished through strategic partnerships with existing organizations that can broker the participation of individuals from UR/US communities

Specific indicators of partnership development should document: efforts made to contact organizations relevant to UR/US communities (e.g., programs at MSIs, groups focused on minority participation in STEM, Boys & Girls Clubs of America); efforts made to develop MOUs between the work of the OER and specific organizations and; the specific actions taken by staff associated with OER and the ship and partnering programs to advance the shared goals of broadening participation.

Analysis of progress in promoting sustained involvement of individuals from UR/US groups in *Okeanos Explorer*/OER activities and related professional growth and learning is considered a Participation & Learning Indicator. Participation & Learning Indicators should involve examination of:

- how members of UR/US groups interact with the ship and OER activities
- how they deepen their participation in related pursuits over time (e.g., returning for future ship and OER events, picking up and pursuing lines of interest related to the interdisciplinary work of the OER, seeking out and engaging in professional or educational experiences related to the OER enterprise).

It is also the case that individuals may develop social capital from engaging with the ship community. Individuals may meet others with shared interests, find a mentor who can help them pursue a STEM interest, or develop relationships that go beyond formal OER activities. If a learning community model is pursued for the *Okeanos Explorer*, finding a method to document the growing social network of relationships and interactions could provide powerful impact data. The use of information technologies aids in social network analysis (e.g., tracking affinity groups, social networking, shared resources, and email interactions).

Working Group: Real-Time Data Use

This working group stated that to determine success for implementing their recommendations, several questions would need to be answered, including: Are these groups using the data? If these groups are using the data, how are they integrating it into their lives? Do they understand it and are they using the information successfully for their specific purposes?

Working Group: New Media/Virtual Environments

The New Media and Virtual Environments working group suggested that success be measured via the quality of new media and virtual environments ; the breadth of participation and contribution of original, creative products that enhance missions; and the number of people/students assisting with video and data stream analysis. It was further success could be determined through analysis of how the different user groups utilize the Web site and other information outlets for the *Okeanos Explorer*.

WHAT SHORT-TERM PRODUCTS/SERVICES DO YOU RECOMMEND OE DEVELOP/OFFER?

Forum participants were asked to rank short-term product recommendations in order of priority 1-3, 1 being highest priority. These rankings were tallied and the results are provided below.

Working Group: Professional Development/Informal Education (K-12)

Priority 1:
A top priority identified by this user group is to repackage existing OE education materials as appropriate and use them as new discoveries are made. They further recommended presenting material in a topic-based format (e.g. seamount, hydrothermal vents, and methane hydrates) versus an expedition-based format. This approach provides an easy method for incorporating lessons and background from new discoveries into topical packages.

Of almost equal importance, participants emphasized the need to bring the ship to life for this audience, suggesting virtual tours of the ship and utilization of webcams, including interviews with the crew, career information and highlighting the experiences of life on an exploration vessel. They also emphasized the importance of developing lessons on the technology behind exploration, highlighting engineering as a key ocean science career.

Priority 2:
This group also felt it is important to provide the K-12 teaching community with regular, free access to updated material via the internet and/or public television.

 Priority 3:
Forum participants emphasized utilizing Web 2.0 avenues such as RSS feeds as priority 3, to keep educators and the general public up to date on activities associated with the ship.

Working Group: Formal Education (13-16)

Priority 1:
The formal working group indicated that a top priority is to provide new products to students in community colleges and undergraduate institutions, utilizing delivery avenues such as live feeds, podcasts, and social networking sites such as Second Life. These products should include content explaining what ocean exploration is, how the *Okeanos Explorer* will execute its missions, the technology aboard the ship and occupations of those working on the ship. They also emphasized the need for faculty instruction on telepresence technology and how it can be used as a teaching tool.

Priority 2:
Forum participants saw importance in creating an online learning environment for undergraduate faculty, providing a resource library, blogs, and webcasts. They noted that this would require some creative advertising as many community college and undergraduate faculty often do not know where to go to get ocean science information. They further suggested a priority target audience be those faculty who teach both science students and pre-service teachers.

Priority 3:
While there was much discussion and debate about the value of social networks like Second Life, it was suggested that, were this to be an avenue pursued, faculty would need a tutorial on how to use this social environment as a teaching tool.

Lastly, this group suggested providing a list of ocean science projects related to the ship that faculty could give to their undergraduate students as topics for community service requirements or course requirements.

Working Group: Underrepresented/Underserved Groups (UR/US)
Note: This group answered Questions 3 and 4 regarding short and long term products and services collectively and their ranked responses are discussed here.

Priority 1:
 The Underrepresented and Underserved audiences working group stressed the need to emphasize the work of diverse professionals associated with the ship, profiling them on web sites and in print, (i.e., not only on the NOAA OE web site but also providing this information to publishers of popular new marine science textbooks such as Life on an Ocean Planet), creating Facebook sites for them, and interviewing them during expeditions, thus creating role models in careers where UR/US students can see future possibilities for themselves.. It was strongly recommended that these professionals be the highest profile members of expeditions and that career information efforts highlight not only scientific careers that are available in ocean sciences, but also the shipboard technical, communications and educational careers.

This group believed it was important to provide strategic portions of the *Okeanos Explorer* expeditions in a variety of languages, at the very least, in Spanish. They further suggested translation of key expedition lesson plans, and possibly interviews with the scientists and ship's crew, into Spanish.

Once some products for this audience are developed, the group recommended contacting science teacher organizations, state departments of education and large urban school districts to provide information on the unique aspect of the OER exploration program and the new ship. One member strongly suggested focusing primarily on states and districts with some history of ocean science material in their curriculum and perhaps initially targeting informal education venues.

The UR/US working group also recommended using the text "Engagement, Capacity, Continuity: A Trilogy for Student Success" (Jolly, E., Campbell, Perlman 2004), a framework for improving the inclusion of underserved and underrepresented students in STEM, as a planning tool to develop new ways to reach diverse audiences.

Priority 2:

Participants in this group recommended NOAA and the ship develop partnerships with programs that serve and support minority undergraduates and graduate students, such as the MS/PhD program and the Marine Academy of Science and Technology (MAST) program, and strive to maintain continuity with UR/US students and families, as well as their teachers. Suggestions included involving UR/US students in delivery of education programs related to the *Okeanos Explorer* expeditions and possibly involving those students in the explorations. MS/PhD students could be incorporated shipboard, interviewing scientists and technicians, interpreting findings and facilitating learning experiences that are broadcast in real time, then archived for future use. College students would benefit from the once-in-a-lifetime opportunity to sail aboard ship, and provide an invaluable service as role models and connecting with iK-12 students after expeditions. Blogs, Facebook sites, and email accounts were mentioned for K-12 students to communicate on an ongoing basis with shipboard guides.

In communities where there is already a strong education partnership (i.e., the NOAA OER Education Alliance partners), this group recommended advertising to UR/US audiences via new/alternative media (e.g., Chinese and Spanish language newspapers, Church newsletters) and community organizations (e.g., Boys and Girls Clubs, Coalition for Science Afterschool) to encourage use of these products in various afterschool programs.

Priority 3:

The UR/US working group recommended establishing telepresence command stations in land-locked areas and at Minority Serving Institutions, stressing that this effort would need to be well-coordinated with high quality programming. Efforts should be made to involve students in authentic projects linked to their faculty advisor's interests to be successful.

While some in this group recommended that future lesson plan development for this audience include interdisciplinary topics beyond the STEM disciplines (e.g., music, art, history/social studies, cultural heritage and Traditional Knowledge), others believed it important to focus limited staff and time resources on maintaining STEM.

Lastly, as an overarching concern, this group was quick to emphasize the need to be reasonable about cost and staff limits in approaching all of the recommendations.

Working Group: Real-Time Data Use

Priority 1:

The working group considering real-time data use for all user groups highly recommended posting notices for upcoming *Okeanos Explorer* expeditions along with the planned objectives and expected

data sets prior to mission launch for user groups to be well-prepared when an expedition actually takes place. They further emphasized the need to provide activities and links to related resources for further exploration.

To best reach all user groups, this group believed it important to have a videographer on board the ship capturing experiences and revealing the human element, especially in early cruises, showing the "real-life" element of new exploration efforts.

As a specific outreach product, the real-time data group recommended a clear description of the modes of exploration adopted by NOAA OER for the ship (reconnaissance, site characterization, water column exploration, mapping) while tying them directly to exploration questions and providing this information prior to an exploration cruise. Additional suggested priority products included depicting life on board the ship in a virtual world such as Second Life and creating and providing tools for active public participation in ocean exploration.

Priority 2:
Additional short term products recommended by this group include: geospatial maps with tagged data (using the efforts of the Monterey Bay Aquarium Research Institute as a model); curriculum based on the operations of the ship emphasizing the physics, chemistry, biology and geology involved in the expedition (adapting lessons already developed); an Ask a Scientist feature directed to those aboard the ship and at Exploration Command Centers; and being certain that news from the ship gets out to the public quickly and is available on demand.

Priority 3:
There were no tertiary level priority short-term products or services recommended by this group.

Working Group: New Media/Virtual Environments

Priority 1:
In agreement with the K-12 working group, the New Media group also identified review of existing lesson plans to plug in new data and connections to the work aboard the *Okeanos Explorer* as a key priority, thus optimizing the use of resources by repurposing current material.

Specifically from the New Media and Virtual Environments perspective, this group strongly recommended Web site expansion; including blogs, live video, and Ask an Explorer, along with a dedicated on-shore web coordinator/interpreter, to best tell the on-going story of the *Okeanos Explorer*. Additionally, they believed that sharing the shakedown cruises was an important element to capture the attention of the general public.

Considering the activities that go on behind the scenes to make this kind of information available to the public, this group stressed the need for accuracy and consistency in creating and tagging metadata and also strongly suggested NOAA OER pay close attention to how people use the Web site, keeping good statistics for future analysis.

Priority 2:
With consideration to the constraints NOAA faces for work within social media sites such as Facebook, the group did recommend building an *Okeanos Explorer* Facebook page either internally or via a third party vendor. Creating a Twitter feed for the ship was equally recommended, with the suggestion that participating scientists get involved in communicating with the general public using this method. However, the New Media group emphasized the importance of setting up guidelines for use of Web 2.0 tools and associated material creation before any social media venues are established for the ship.

Priority 3:
While all Forum participants were intrigued with the material on the *Okeanos Explorer* that has been built in Second Life to date, expanding on this effort with integrated lessons and content was not considered a top priority.

WHAT LONG-TERM PRODUCTS/SERVICES DO YOU RECOMMEND OE DEVELOPING/OFFERING?

Forum participants were each asked to rank their long-term product recommendations in order of priority 1-3, 1 being highest priority. These rankings were tallied and the results are provided below.

Working Group: Professional Development/Informal Education (K-12)

Priority 1:
For the K-12 group, the top long-term product and services suggestions were similar to the short- term suggestions with the highest priority being, through the use of webcams, high definition cameras, and similar technology,, the need to capture the enthusiasm of discovery among the crew as it is happening , to share it with classrooms and the general public, and to document/capture it for future use. Equally, they mentioned that revision of current products could be considered both short- and long-term efforts, updating curricula and professional development offerings as new features, events, and technologies arise, and adding lessons on new topics over time as discoveries are made.

Priority 2:
The K-12 group saw the development of online courses, workshops and seminars as important long-term products and services associated with the ship.

Priority 3:
Given the interdisciplinary science aspects of using high-definition camera and video technology aboard the ship, this group suggested incorporating film competitions into future education offerings.

This group further recommended creating a method to incorporate teachers into the communication work at Exploration Command Centers and suggested that PBS Television programming would be a good avenue for high visibility. NOVA and National Geographic were also mentioned by this group as possible avenues for long-term product creation.

This group brought up a concern regarding the fact that on board any exploration or research vessel there are, inevitably, long periods of monotonous, repetitive work interspersed with the occasional exciting event. NOAA OER must consider how best to show the public and students this reality while still focusing on the excitement and importance of ocean exploration and the potential for new discoveries.

<u>Working Group: Formal Education (13-16)</u>

Priority 1:
The formal education group's top recommendation was to create a mechanism for ensuring community colleges and undergraduate schools, including those serving pre-service STEM educators, have a way to participate in the expeditions at remote consoles, paying particular attention to placing these at Minority Serving Institutions and smaller, underserved institutions. They further suggested developing a semester-long course about ocean exploration to include the philosophy behind OE, the history of ocean exploration, the modern day need for OE, tools used in OE, and the expeditions of the *Okeanos Explorer*.

Lastly, in an effort toward workforce development, a key long-term service suggestion from the formal education group was the development of a ship internship program via the Marine Advanced Technology Center's internship program for community college students.

Priority 2:
The formal education group suggested development of a program similar to the very successful Research Experience for Undergraduates (REU) program with annual cohorts of students (vs. a single student at a lab/office) placed at the Exploration Command Centers around the country. It was recommended that the participants not be limited to science majors and that the cohorts be comprised of interdisciplinary teams of students majoring in subjects such as education, journalism, and science illustration. A suggestion was made to focus more intensely on the communications aspects and seek funding from sources like the MacArthur Foundation.

The idea of a Distinguished Lecturer Series on Ocean Exploration that could be webcast and archived for university use was also appealing to this group. They suggested using the Integrated Ocean Drilling Program (IODP) lecture series as a model. http://www.iodp.org/drills.

Priority 3:
With the comment that this will evolve as communities are engaged, the group saw providing Ocean Exploration programming for lifelong learners via evening seminars and Elderhostel courses through university and community college systems as another avenue for positive public engagement.

Working Group: Underrepresented/Underserved Groups
Note: This group answered Questions 3 and 4 regarding short and long term products and services collectively and their ranked responses are discussed under Question 3.

Working Group: Real Time Data Use

Priority 1:
The Real Time Data Use group again emphasized the importance of providing easy access to archived data sets, lessons and similar products from the ship expeditions. They strongly suggested providing the capability for the public to search through video clips for anomalies and "cool stuff" and to interact with professional and citizen scientists using tools like Flickr and You-Tube. That is, allowing people to tag and discuss videos and pictures and possibly create their own video mash-ups. This group also noted the importance of developing tools to be able to combine data sets into customized products.

Priority 2:
This group suggested providing a searchable database (e.g., a map application) to enable individual's to create their own online explorations and provide their own tags (e.g., www.gigapan.org).

Priority 3:
This group liked the idea of developing an Explorer Corps/Citizen Science Ambassadors, but had concerns regarding funding for such an effort.

A few additional comments came from this group after the ranking process was completed:
• Consider making less common types of real-time data sets available, like audio conversations (communications chatter) and ship engineering data.
• Develop framework lesson plans (rapid-response shells) for potential new areas of discovery that can be augmented and released when discoveries are made.
• Develop a tool to quickly review a mission and all its integrated datasets (i.e. the *Alvin* Frame Grabber http://4dgeo.whoi.edu/alvin).
• Develop family-based resources.

Working Group: New Media/Virtual Environments

This group believed it important for NOAA OER to find ways to get the public broadly engaged in the decision-making process associated with the explorations of the *Okeanos Explorer*, providing both short-term and large-scale participative activities that create a sense of coming along on the exploration.

Priority 1:
The new media group broadly identified defining, building and implementing approaches for blending learning, incorporating the local/ "near me" aspect, the online and telepresence capabilities, and life on the ship out at sea. It was deemed essential to engage the ship crew in the education mission and the use of new media in order to accomplish this and many of the recommendations set forth.

This group also suggested developing more Multimedia Discovery Missions (http://oceanexplorer.noaa.gov/edu/learning/welcome.html) targeting topics associated with the explorations of the *Okeanos Explorer* and creating a virtual *Okeanos Explorer* Advisory Group comprised of communicators, public relation specialists, educators and students.

Priority 2:
This group emphasized the need to share the operations of the ship with the public via unfettered, transparent communication.

They also suggested developing an Ocean Explorer Corps for young people, but questioned the feasibility of a program of this nature.

Priority 3:
This group liked the idea of ship gaming possibilities with existing systems (e.g., Xbox, Wii) and simulated ocean exploration through avenues such as Second Life. It was suggested that SciLands accounts could be created for classrooms, though several security needs were discussed. This would also require training for both NOAA education staff and for teachers to be effective.

OCEAN LITERACY PRINCIPLE #7

During the Forum, participants were introduced to the Ocean Literacy Essential Principles and Fundamental Concepts, specifically Principle seven, ***The ocean is largely unexplored***.
(Appendix 4). Participants were asked to review this principle's associated Fundamental Concepts to identify unique programmatic capabilities for addressing them.

FC (a)   The ocean is the last and largest unexplored place on Earth— less than 5% of it has been explored. This is the great frontier for the next generation's explorers and researchers, where they will find great opportunities for inquiry and investigation.

All participants agreed that ocean exploration requires a broader, more engaged and concerned constituency and that the *Okeanos Explorer* can be a key catalyst for stimulating interest, understanding and action. They articulated the need for effective media efforts to excite the world regarding her capabilities and discoveries, marketing her as America's ship of exploration, and for providing quality interpretation of the ships activities. They described the ship as a key, unique tool to inspire further inquiry and noted that, through the work of the ship, NOAA can play a stronger role in investigation and inquiry teaching strategies important to the future.

FC (b)   Understanding the ocean is more than a matter of curiosity. Exploration, inquiry and study are required to better understand ocean systems and processes.

Forum participants discussed the intrinsic nature of exploration, agreed that understanding the ocean is much more than a matter of curiosity, but saw the *Okeanos Explorer* as a tool to capture that curiosity. It will require thoughtful, quality programming to share the wonders of ocean exploration associated with the ship and modern ocean issues with the general public, teachers and students worldwide.

FC (c)   Over the last 40 years, use of ocean resources has increased significantly, therefore the future sustainability of ocean resources depends on our understanding of those resources and their potential and limitations.

It was emphatically agreed upon that there is not enough attention, both in media and in education, paid to the sustainability of our ocean, climate change and the associated impact on the planet and human health. In light of these powerful issues, participants agreed that through both public relations and education efforts, NOAA OER can use the exciting, cutting-edge explorations and discoveries of the ship to emphasize the importance of exploring and understanding our vastly unknown ocean.

FC (d) **New technologies, sensors and tools are expanding our ability to explore the ocean. Ocean scientists are relying more and more on satellites, drifters, buoys, subsea observatories and unmanned submersibles.**

With the capabilities of this new Federal vessel, the United States is moving into a whole new paradigm of how science and exploration are done. The tools and capabilities of the *Okeanos Explorer* are relatively new to the science community and exemplify the need for constant innovation. It was clear to the Forum participants that highlighting the unique assets of the ship in education arenas can inspire engineers and designers of the future.

FC (e) **Use of mathematical models is now an essential part of ocean sciences. Models help us understand the complexity of the ocean and of its interaction with Earth's climate. They process observations and help describe the interactions among systems.**

The Forum group that discussed Real Time Data Use noted that there will be a great deal of interest in raw data coming from the ship. The *Okeanos Explorer* will promote a wide range of opportunities for interaction with the ship and the data collected. Collected data will be available in real time and archived for use when data are not available and for comparative purposes. Tools will be available for users to combine data sets into customized products.

FC (f) **Ocean exploration is truly interdisciplinary. It requires close collaboration among biologists, chemists, climatologists, computer programmers, engineers, geologists, meteorologists, and physicists, and new ways of thinking.**

Several participants noted that all efforts associated with the *Okeanos Explorer*, including the Web site, life on the ship, and the exploration technology, emphasize interdisciplinary science, diversity of people, careers, cooperation and collaboration. From informal and formal education to underrepresented and underserved populations to individuals interested in real-time data and new media environments, the interdisciplinary aspect of ocean exploration is clear. Educators can use the enthusiasm generated by the *Okeanos Explorer*'s methods of discovery to stimulate students' interest in many types of ocean-related career opportunities, far beyond strictly those of scientists. The exciting work of the ship can certainly be used to share the wide range of employment opportunities and expected job competencies associated with ocean exploration with many different audiences.

The work of the *Okeanos Explorer* can tell the story of modern ocean exploration in a number of arenas. Utilizing Web 2.0 capabilities such as Twitter, Flickr, Facebook and You-Tube, and virtual environments, NOAA OER can reach audiences that might not be reached through other avenues. Participants made it explicitly clear that NOAA OER needs to answer the question "So what?" for the general population. Consider riding in a taxi and starting a discussion with the cab driver regarding the fact that 95% of our

ocean is unexplored. He or she may respond with "So what?" The dynamic activities of the ship can be utilized in unique, captivating ways to show the general public a world few know even exists on our planet and how it directly impacts their lives and the future of life on the planet.

CONCLUSION

The *Okeanos Explorer* Education Forum participants discussed at length the importance of making the *Okeanos Explorer* "come alive" by capturing the enthusiasm of the ship's officers and crew as they live and work onboard the Nation's first dedicated ship for ocean exploration. This is of particular importance in fulfilling NOAA's Education Mission to "advance environmental literacy and promote a diverse workforce in ocean, coastal, Great Lakes, weather, and climate sciences encouraging stewardship and increasing informed decision making for the Nation." The America COMPETES Act (2007)[3] mandates that NOAA build on its role in stimulating excellence in the advancement of ocean and atmospheric science and engineering disciplines and provide opportunities and incentives for the pursuit of academic studies in science, technology, engineering, and mathematics (STEM) content areas. The educational program developed for the *Okeanos Explorer* clearly will offer outstanding opportunities to address the requirements of the America COMPETES Act[3] and will be in direct alignment with NOAA's Education Strategic Plan[4] which has two goals: 1) environmental literacy and 2) workforce development.

Opportunities identified during the Forum are being prioritized and strategies addressing these opportunities will eventually form the blueprint for the NOAA Ship *Okeanos Explorer* Education Program. Over the past 3 years, several partnerships have been established and products produced based on the Forum recommendations.

Updates
Okeanos Explorer Education Materials Collection
The *Okeanos Explorer* Education Materials Collection has been developed to encourage educators, students, and citizen scientists to become personally involved with the voyages and discoveries of the ship. Two volumes of the Collection have been created. Volume 1: *Why Do We Explore?* targets modern reasons for ocean exploration and Volume 2:*How Do We Explore?* focuses on the search for anomalies and exploration technologies. Each Volume includes an introductory lesson on the overall theme and three lessons each of several specific topic areas, one lesson for each grade level (5-6, 7-8 and 9-12). The series of lessons for each theme guides student investigations that explore these topics in greater depth.

Online Educator Professional Development

In cooperation with the College of Exploration, NOAA OER is sponsoring online professional development for educators in conjunction with the development of the above Education Materials Collection. A two week *Why Do We Explore?* course was offered both in October 2009 and June 2010. How Do We Explore? was offered in January 2011, following the first exploration season of the ship.

***Okeanos Explorer* Web Pages and Expedition Education Modules**

Beginning with the ship's maiden voyage to Indonesia in the summer of 2010, NOAA OER has partnered with explorers to provide education modules filled with background information, essays and lesson plans associated with the science behind each expedition.

Digital Atlas and Lessons

The NOAA Coastal Data Development Center is providing a cutting edge Digital Atlas that has proven to be an exceptional tool for teachers and the general public to follow along with the expeditions of the ship in near real-time. Currently maps, CTD data and graphs, and video are available in the Atlas, all linking back to the information on the NOAA OE Web site. Lessons are being created using data from the ship in near real time. This mapping technology is still under development and new capabilities and more products are expected in the coming year.

Partnership with the San Francisco Exploratorium

Through a partnership with the San Francisco Exploratorium, San Francisco's most prominent science museum, NOAA OER has created an online presence for the *Okeanos Explorer* at www.explo.tv. In these live webcasts educators at the Exploratorium interact with marine scientists at the *Okeanos Explorer*'s Exploration Command Center in Seattle, Washington and explorers in the control room aboard the ship to discuss the mission's discoveries and view video of some of the amazing animals they encountered. This partnership enabled NOAA to share background on the ship's exploration mission, its unique technical capabilities, and exciting discoveries with the general public in real and near-real time , and currently through archived online video.

OceanAGE and Ship Crew Careers

NOAA OER has expanded the OceanAGE career element of the Ocean Explorer Web site and will soon incorporate interviews with ship officers, engineers and crew members and information on careers connected with the vessel.

***Current*: The Journal of Marine Education**

In April 2012, an issue of *Current*, The Journal of Marine Education, entitled "A Closer Look at Ocean Careers through the NOAA Ship *Okeanos Explorer*: A Case Study" was produced. Interviews and essays include those from NOAA Corps Officers, the ship's chief bosun, survey and mapping technicians, a technical operations expert, an ROV pilot and engineer, educators, a web designer, an electronics

technician, and an engine utility [wo]man. This issue shares the career paths traveled and daily work routines of those who dedicate their lives to understanding more about our little-known ocean world.

Web 2.0

As technology improves and web access and capabilities expand, NOAA OER is providing lessons, videos and images via RSS feeds, Twitter, Flickr, and You Tube. Use increases every day with ~ 400 lessons per day currently being downloaded via RSS feeds.

APPENDICES

1) Forum Agenda
2) Participant Biographies
3) Forum Breakout Groups
4) Ocean Literacy Essential Principle #7
5) Additional Points Caught by NOAA OE Staff During Discussions

REFERENCES

1   Discovering Earth's final Frontier: A U.S. Strategy for Ocean Exploration. The Report of the President's Panel for Ocean Exploration, 2000.
    http://explore.noaa.gov/media/http/pubs/pres_panel_rpt.pdf

2   The Ocean Literacy Principles and Fundamental Concepts.
    http://www.coexploration.org/oceanliteracy/documents/OceanLitChart.pdf

3   America COMPETES Act of 2007, and America COMPETES Reauthorization Act of 2010 Reauthorization 2010.
    http://www.commerce.gov/americacompetes

4   National Oceanic and Atmospheric Administration Education Strategic Plan 2009-2029.
    http://www.oesd.noaa.gov/NOAA_Ed_Plan.pdf

NOAA Ship *Okeanos Explorer* Education Forum Agenda

Meeting Goal: Develop the building blocks for a 5-year education program plan for the NOAA Ship *Okeanos Explorer*, America's first ship dedicated to ocean exploration. "Reaching out in new ways to stakeholders to improve the literacy of learners of all ages with respect to ocean issues" should be the overarching theme for this plan. *Discovering the Earth's Final Frontier: A U.S. Strategy for Ocean Exploration, 2000*

Day One – Thursday, August 14

8:00 Continental Breakfast

8:30 Workshop Goals and Objectives
- Welcome - Dr. Stephen R. Hammond, Acting Director, NOAA Ocean Exploration Program and Dr. Bruce Gillman, Ocean Exploration Advisory Working Group of the NOAA Science Advisory Board
- Participant Introductions
- Agenda and Working Groups Overview
- What is Meant by "In New Ways?" – Large Group Conversation

9:15 Plenary One:
- The NOAA Ship *Okeanos Explorer*: Capabilities and Assets, John McDonough, NOAA Ocean Exploration Program
- Ocean Exploration Education Program: From Then to Now, Paula Keener-Chavis, NOAA Ocean Exploration Education Program
- How People Learn with New Technologies and Implications for the Okeanos Explorer Education Program, Dr. Phil Bell, COSEE Ocean Learning Communities, University of Washington

10:30 Break

10:45 Plenary Two:
- Evolving towards the NOAA Ship *Okeanos Explorer* Virtual Learning Community, Peter Tuddenham and Tina Bishop, The College of Exploration
- Exploring the Use of Real-Time Data in the Classroom, Leisl Hotaling
- Bringing Real-Time Imagery to the Public, George Matsumoto, MBARI
- The *Okeanos Explorer*: A Virtual Perspective, Eric Hackerthorn, NOAA

12:05 LUNCH (On site) Virtual Interaction with The NOAA Ship *Okeanos Explorer*

12:45 Working Groups
- Introductions, review group process for addressing questions

2:45   Break

3:00   Working Groups (continued)

4:00   Report Out to Large Group

5:00   Conclude

Day Two – Friday, August 15

8:00   Continental Breakfast

8:30   Overview of Agenda and Tour of NOAA Ship *Okeanos Explorer*

- Welcome and Introduction to Tour Leads, Commanding Officer Joseph Pica, Lt. Commander Jeremy Weirich

9:30   Return to Conference Room

9:30   Break

9:40   Debrief on Ship Tour

10:00   Working Groups: Continue Work on Questions
- Discussion of new or deleted actions based on previous days' large group report out
- Priority-setting of final set of recommendations

11:30   Large Group Report Out

12:15   Working Lunch (On Site)
- NOAA Ship *Okeanos Explorer* and the NOAA Education Plan – Facilitator, Sarah Schoedinger, NOAA Office of Education

1:30   Working Groups Address Ocean Literacy Essential Principle #7
- Review Fundamental Concepts to identify unique programmatic capabilities for addressing them
- Prioritize recommendations

2:30   *Okeanos Explorer* Education Program Recommendations and Next Steps
- Working Groups Report Out Prioritized Recommendations to Large Group
- Large Group Open Reflections

4:00   Workshop Evaluation and Adjourn

NOAA Ship *Okeanos Explorer* Education Forum, August 14-15, 2008
Ocean Exploration and Research Program

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Philip Bell

Phil is an associate professor of the Learning Sciences at the University of Washington. He also directs the ethnographic and design-based research of the Everyday Science and Technology Group (http://everydaycognition.org). Phil has developed a cognitive and cultural program of research within diverse environments focused on personally consequential learning across social settings. He has studied everyday cognition and expertise in science and health, children's argumentation, the use of digital technologies within youth culture, the design and use of novel learning technologies, and new approaches to inquiry instruction in science. Phil is the director of the UW Institute for Science and Math Education, a Co-Lead of the Learning in Informal and Formal Environments (LIFE) Center (http://life-slc.org/) and is a Co-PI of COSEE-Ocean Learning Communities (http://cosee-olc.org/). He also serves as a member of the Board on Science Education with the National Academy of Sciences and co-chairs the NRC Consensus Committee on Learning Science in Informal Environments.

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Tina Bishop

Tina is Founder, Academic Director, and Financial Officer at the College of Exploration in Virginia. Tina has over 15 years experience in assessment of K-12 and extensive experience working with NOAA, Department of Defense Dependents' Schools, National Geographic, the Center for Ocean Leadership, National Science Foundation's Centers for Ocean Sciences Education Excellence (COSEE), USC Sea Grant, and other federal, private, and international partners to design and implement online professional development programs and to conduct educational research and program evaluation. She is focused on developing collaborative learning communities for educators that provide online interactions with scientists and information about the latest scientific research.

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Valerie Chase

Valerie made her way to Baltimore from California in the 70s, with a period of time spent teaching at Richard Stockton College in NJ and as Dept. Chair at Salem College in NC in between. She moved to Maryland with her husband, marine ecologist Bill Johnson, who was a professor at Goucher. There Valerie joined the staff of the then under construction, National Aquarium in Baltimore. During her 23 years at NAIB, she did a wide variety of jobs with teacher education and curriculum development while supported by NSF and HHMI grants. A few years ago she retired from her position as Director of Education. Shortly thereafter, Valerie began consulting with the Ocean Exploration education program, editing *Learning Ocean Sciences through Ocean Exploration* and beginning the partner teacher workshop program.

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Sue Cook

Sue is Education Director for the CORE Division of the Consortium for Ocean Leadership where she is PI on federal grants for the National Ocean Sciences Bowl. Between 2001 and 2004, she served as Associate Program Director for Ocean Education in the Division of Ocean Sciences at the National Science Foundation. Prior to her NSF service, Dr. Cook worked for 17 years as a practitioner and administrator linking scientists to educators at two ocean research institutions Harbor Branch Oceanographic Institution and the Bermuda Biological Station for Research (now the Bermuda Institute for Ocean Science). Before shifting to a primarily educational role, Dr. Cook held faculty and research appointments at UCLA and Ohio State University with a focus on the behavioral ecology of subtropical marine mollusks. Sue serves as Secretary for The Oceanography Society (TOS) and is Vice Chair for the Marine Technology Society's Education Committee.

NOAA Ship *Okeanos Explorer* Education Forum, August 14-15, 2008
Ocean Exploration and Research Program

Annette deCharon

Annette is the Senior Marine Education Scientist, at the University of Maine, Darling Marine Center. Since 1997, she has authored over 30 web-based and other multimedia publications including the award-winning "Phytopia: Discovery of the Marine Ecosystem" CD-ROM. She is currently Director of COSEE-Ocean Systems where her long-term goal is to help the COSEE Network reach rural and inland audiences. Annette also serves as the education lead for NASA's upcoming Aquarius mission (2010 launch) which will measure global ocean surface salinity.

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Joe Flood

Joe is the Web Project Manager for NOAA Ocean Explorer. He has more than twelve years of experience in the development of effective Internet content for the large-scale web sites of major organizations such as AARP, The Nature Conservancy and NOAA. Joe has been a part of the Office of Ocean Exploration and Research for three years.

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Catherine Giddens

Catherine is an Instructional Technology Specialist, South Carolina Department of Education.
She has designed and facilitated technology integration courses and workshops for many K12 teachers in the Charleston, SC region and statewide over the past 8 years. Catherine has completed extensive training and received certification in online course design and facilitation through ETLO (Educational Technology Leaders Online) and PBS Teacherline. She is a former elementary school teacher and has instructed teacher recertification courses in integrating technology.

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Bruce Gilman

Bruce is a member of the NOAA Ocean Exploration Advisory Working Group (OEAWG) and currently serves as President of the Marine Technology Society (MTS). Bruce has participated in offshore operations, designed and developed equipment and has served as Chairman, President and CEO of some the most preeminent subsea engineering and service contractors and equipment manufacturers. He has served on the National Academy of Science, National Research Council Committee on Exploration of the Seas and also the Committee on Future Needs in Deep Submergence Science, served on National Ocean and Atmospheric Administration's (NOAA) Ocean Exploration proposal review panels and served on the Texas Sea Grant College Program Advisory Committee.

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Mel Goodwin

Mel is a marine biologist who heads a nonprofit information services organization devoted to sustainable development. He has taught middle-school, high school, and university levels courses, and has authored several hundred lesson plans on ocean science subjects for NOAA, as well as a 150-page activity book for NOAA's 200th Anniversary Celebration.

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Myles Gordon

Myles is a consultant to museums and other organizations on strategic planning and educational programming, working with Smithsonian Institution NMNH, California Academy of Sciences, Louisiana State Museum, Sesame Workshop, Intrepid Museum of Sea, Air and Space, and others. Prior to this freelance work, he served as Vice President for Education at the American Museum of Natural History, responsible for onsite, local, and national programming; product development including online professional development for teachers; and supervision of all digital video planetarium shows. Before working in the museum community, he served as Senior Vice President at Education Development Center, Inc. He serves as an advisor to National Academy of Sciences Committee on Learning Science in Informal Environments, and is a member of the editorial boards of several professional journals. One of the highlights of his life was participating in the REVEL program and going on a three week research cruise on the Juan De Fuca Ridge.

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Susan Gottfried

Susan is an employee of General Dynamics Information Technology and is contracted to NOAA's National Coastal Data Development Center (NCDDC) at John C. Stennis Space Center on the Mississippi Gulf Coast. Susan has been involved with data management efforts for the Office of Ocean Exploration for four years. NCDDC participates in an OE Data Management Integrated Product Team (IPT) made up of members from several NOAA offices divided into working groups focused on *Okeanos Explorer* Data Strategy, Expedition Data Management and Policy, the Cruise Information Management System (CIMS), and Products. The IPT Products Working Group is focused on developing data driven applications used for science, research, outreach, and education purposes, such as GIS and other geospatial applications, websites, and metadata and archive tools.

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Eric Hackathorn

Eric started with his first computer before he learned to ride a bicycle. His father was kind enough to allocate him 100 KB of the family's 10 MB hard drive: one of the first commercially available of its kind. Since that time, he has spent a majority of his time dabbling in all things computer related. After graduating from high school, he started working for the National NOAA in Boulder, Colorado. With a degree in electrical and computer engineering, he continues his work at NOAA today as a program manager.

Eric has taken a back seat to his much handsomer counterpart Hackshaven Harford. Hackshaven is Eric's avatar (a virtual representation of himself) and exists only in the virtual world known as Second Life. Together they have been busy designing a public 3-D space to highlight the research NOAA performs. In addition, they recently formed a company "Maya Realities" to explore 3-D virtual world metrics. In essence, helping to gauge the return on investment for companies creating beachheads in virtual worlds such as Second Life.

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Susan Haynes

Susan is the Education Program Manager for NOAA's Office of Ocean Exploration and Research (OER). She manages Ocean Exploration teacher professional development workshops in cooperation with 17 national Alliance partners and will be working to develop education programming in conjunction with the *Okeanos Explorer.* Susan spent the past 4 years as the Director for the National Ocean Sciences Bowl at the Consortium for Ocean Leadership (CORE division) in Washington, D.C. Formerly an Education Specialist for Virginia Sea Grant at the Virginia Institute of Marine Science, her past work has included working with scientific faculty to design graduate courses for teachers and developing classroom activities using authentic research data. She has also been an Education Specialist at Oregon Coast Aquarium and National Aquarium in Baltimore. Susan has 20 years of experience in marine education and has spent a significant portion of her career working to better engage marine scientists in student and teacher education.

NOAA Ship *Okeanos Explorer* Education Forum, August 14-15, 2008
Ocean Exploration and Research Program

Liesl Hotaling

Liesl is the Chief Education Officer for The Beacon Institute for Rivers and Estuaries in Beacon, New York. She holds a B.A. in Marine Science, a M.A.T. in Science Teaching, and a M.S. in Maritime Systems (ocean engineering). She is a partner in Centers for Ocean Science Education Excellence - Networked Ocean World (COSEE-NOW) and specializes in real time data and hands-on STEM educational projects supporting environmental observing networks.

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Paula Keener-Chavis

Paula is Director of the National Oceanic and Atmospheric Administration's (NOAA's) Ocean Exploration's Education Program. Paula is a marine biologist and ocean science educator who works closely with scientists and educators to reach out in new ways to educators, students, and the general public through NOAA ocean exploration expeditions to enhance ocean sciences literacy. Paula served as a member of The President's Panel on Ocean Exploration and as a member of the National Academies Committee on Exploration of the Seas. She serves on the NOAA Education Council the National COSEE Council. She served as a member of the Smithsonian Institution's National Museum of Natural History's Ocean Hall Statement of Purpose Team and is a Past-President of the National Marine Educators Association. She has spent over 280 days at sea studying our ocean and its inhabitants.

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Dave Lavolvo

Dave is the founder and owner of Eastern Oceanics. For 30 years, he has filmed and supported underwater research projects in just about every major ocean and many of the world's major inland lakes. Dave has spent 23 years exploring, filming and mapping Yellowstone Lake and continues to support projects in Yellowstone and many other locations around the world. He has been an engineering consultant to Woods Hole Oceanographic Institution, working with the manned submersible *Alvin* and has been a pilot and/or member of the design team for the ROV *Jason*, Jason 2, *Hercules*, and *Little Hercules*. He is an adjunct to the engineering program at the Institute for Exploration and a Visiting Scholar at the University of Rhode Island's College of Engineering, Department of Ocean Engineering.

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Sage Lichtenwalner

Sage currently works in the Rutgers University Coastal Ocean Observation Lab (RU COOL), where he serves as the group's "data translator." He is tasked with transitioning research data and stories into operational products for use by K-12, informal and general public audiences using a variety of data management, visualization and interactive web interface technologies. Sage has been involved with the design and development of dozens of web sites over the past 10 years, and actively pursues developments in the fields of data visualization, online education and science communication.

As a member of COSEE Networked Ocean World, Sage is directing the development of an online portal (http://coseenow.net) to foster community collaborations among scientists and educators, and is also responsible for the COOL Classroom (http://new.coolclassroom.org) - an online guided-inquiry based curriculum that incorporates real-time data from ocean observing systems.

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Catalina Martinez

Catalina manages OER's regional office in Rhode Island, and facilitates collaboration between NOAA, URI's Graduate School of Oceanography, and the Sea Research Foundation's Institute for Exploration (IFE). The efforts of this dynamic collaboration, in large part, have focused on the development and application of telepresence technology and its associated shore-based facilities for the purpose of ocean exploration and research, and public outreach and education. With the permanent installation of the technology to enable telepresence on board NOAA's new dedicated ship of Exploration, the *Okeanos Explorer* (EX), Catalina works as part of a team to see that the ship is equipped with the systems and personnel to fully realize the vision of sharing the excitement of discovery and ocean science with the public on shore in real time. Catalina also participates as part of the OER outreach and education team, focusing on development of opportunities and programs for underrepresented and underserved populations.

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John McDonough

John served as a physical scientist with NOAA's National Ocean Service from 1989 to 2002, where he developed data and geographic information systems related to coastal and marine environments, and applied that information to help prepare management plans for marine protected areas. From 1998 to 2002, John was the project manager for large-scale undersea research expeditions using a variety of tools and techniques, including manned and unmanned submersibles. Specific efforts include the Sustainable Seas Expeditions, a joint endeavor between NOAA and the National Geographic Society to explore the system of National Marine Sanctuaries managed by NOAA's National Ocean Service. John initially joined the NOAA Office of Ocean Exploration as the Operations Coordinator in January 2003, and has been the office's Deputy Director since 2005. He is committed to exploring and learning more about natural systems in marine and coastal areas, and providing the data and information required for effective ecosystem-based management.

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Mary K. Miller

Mary is a science writer, Web producer, and project director for the Exploratorium's Online Engagement Group. She has degrees in marine biology and science communication from U.C. Santa Cruz and is actively involved in bringing current scientific research to public audiences through museum programs, Webcasts, and virtual field trips to remote research locations. She is currently the principal investigator for an NSF-funded International Polar Year project called Ice Stories (icestories.exploratorium.edu). This online and museum project involves museum producers and young polar field researchers contributing dispatches, video and audio clips and photographs to a continuously updated polar news portal. Mary has just returned from a production trip to Greenland in July, where she interviewed glaciologists, geologists and biologists in their research camps and will be heading to Antarctica in November 2008.

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Kimberly Morris-Zarneke

Kim is the Manager of Education Programs for the Georgia Aquarium and responsible for developing and implementing professional development opportunities. Georgia Aquarium is one of 17 NOAA Ocean Exploration Alliance partners, hosting OE teacher professional development workshops focused on deep ocean science and technology. Kim also oversees curriculum and exhibit development in the Aquarium's Education space. Prior to her current position, Kim worked with the Department of Natural Resources Adopt-A-Stream program, at Zoo Atlanta as their Distance Learning Manager and at National Aquarium in Baltimore as their Conservation Coordinator.

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Davida Remer

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Davida has been with NOAA for 23 years. Currently, she leads an integrated Web site development team that serves and/or maintains more than 75 Web sites. She's been involved in the planning and development of numerous interagency, NOAA and National Ocean Service Web sites over the last ten years. In this role Davida was part of the team that developed and built the initial Ocean Explorer Web site and served as production manager for the site from 2001 to 2005. She continues to work with the Ocean Explorer Web site team on new ways to use Internet technologies to make Ocean Explorer expeditions more accessible to the public.

Craig Russell

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Craig is a strategic planning consultant with Earth Resources Technology, Inc. (ERT), to NOAA's OAR Office of Ocean Exploration and Research (OER). His primary activity is coordinating the development of the OER *Okeanos Explorer* (EX) Program, a program within OER, focused on utilizing EX to achieve OER's exploration goals. Craig brings to the discussion an interdisciplinary perspective and vision for EX development.

Sarah Schoedinger

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Sarah is a Senior Program Manager at NOAA's Office of Education. There she manages the Environmental Literacy Grants program, oversees a professional development program for NOAA's educators and serves as a liaison to organizations with missions and programs which complement NOAA's. Sarah is one of the leaders in the campaign to increase ocean literacy, defining ocean literacy and identifying the essential principles and fundamental concepts for grades K-12 and is working to promote these concepts at the national level.

Gail Scowcroft

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Gail is the Associate Director of the University of Rhode Island Graduate School of Oceanography's (GSO) Office of Marine Programs where she directs a host of ocean science education and outreach programs. She is currently serving as the Executive Director of the National Centers for Ocean Sciences Education Excellence (COSEE) Network. Prior to this, she was a senior research associate at GSO and at the Woods Hole Oceanographic Institution. Scowcroft has more than 18 years of experience conducting ocean science research focused on climate change and climate reconstruction and 15 years of experience developing and administrating education and outreach programs. She has published many manuscripts on her research, presented results at numerous scientific conferences, and produced three award winning ocean science education web sites. She also lectures internationally on improving science education and bringing global environmental issues into K-16 classrooms.

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Craig Strang

Craig is Associate Director of Lawrence Hall of Science and leads the School Programs Division and Center for School Change. He is the founding Director of MARE: Marine Activities, Resources & Education, a K-8 professional development/curriculum development program that works with whole schools to increase learning and language acquisition for English-language learners. Craig is the author of three sets of science and environmental education curriculum materials: Proyecto SOL: Science Oriented Learning, Project OCEAN, and MARE. He is also the co-author of three LHS Great Explorations in Math and Science (GEMS) teacher guides: *On Sandy Shores, Ocean Currents,* and *Only One Ocean.* He was the consultant responsible for creating a high school environmental justice internship program, XCEL: Cross-Cultural Environmental Leadership. Craig's interest in using inquiry-based science instruction to promote second language acquisition led him to explore broader issues related to science and literacy. This resulted in a new professional development project, SKILL: Science Knowledge through Inquiry & Language Literacy. Craig has conducted field research on elephant seals and humpback whales, and occasionally leads eco-tours to Baja California and Galapagos.

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Peter Tuddenham

Peter is the co-Founder/President of the College of Exploration (TCOE) in Virginia. TCOE works to engage educators and scientists in education and planning programs through online learning programs about Ocean, Earth, Space and a variety of Geosciences. TCOE supports the mission and work of NOAA's Office of Ocean Exploration with a variety of online programs including virtual teacher workshops and is currently developing a new series of Classroom Exploration of the Ocean online programs focused on the *Okeanos Explorer* and a series of career focused Ocean Age programs.

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Sharon H. Walker

Sharon is a Professor Emeritus within the Department of Coastal Sciences (COA), The University of Southern Mississippi (USM)-Gulf Coast Research Laboratory (GCRL); Director of Education, MS-AL Sea Grant Consortium (MASGC); and Special Projects—Education Officer for the National Oceanic and Atmospheric Administration's (NOAA) National Sea Grant College Program and NOAA's Office of Education. She has served in a leadership capacity in regional and national collaborations since 1987 in precollege, formal, and informal ocean sciences, coastal processes, and global climate change education projects. Sharon's extramurally-funded education research has successfully "bridged the gap" between ocean sciences and coastal processes research and the relevance of those data to precollege teachers, students, and the general public. Sharon is a Board Member for the Gulf Coast Ocean Observing System and the Mississippi Education Lead for the Gulf of Mexico Alliance.

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Vivian Williamson Whitney

Vivian is the Director for the Institute for Environmental Sciences Education and Research at East Central University in Oklahoma. She is a member of the leadership team for the *Minorities Striving and Pursuing Higher Degrees of Success* (*MS PHD'S*) *Professional Development Program,* a program jointly funded by NSF and NASA to reduce gaps in preparation, representation, and full participation of minorities in Earth system science. The program is housed within the Institute for Broadening Participation. IBParticipation.org is a portal website supporting pathways to the STEM fields: science, technology, engineering, and mathematics. Particular emphasis is placed on connecting traditionally underrepresented groups with STEM programs and resources, including funding and mentoring opportunities.

Forum Breakout Groups and Questions Posed

Professional Development/Informal Education (K-12)
Facilitator: Sharon Walker; Rappateur: Susan Haynes

Formal Education (13-16)
Facilitator: Gail Scowcroft ; Rappateur: Davida Remer

Underrepresented/Underserved Groups
Facilitator: Vivian Williamson Whitney; Rappateur: Catalina Martinez

In what unique and new ways can the NOAA Ocean Exploration Program take advantage of the capabilities and assets offered through the *Okeanos Explorer* to enhance ocean science literacy based on:
1. What the users in your area of expertise want to achieve and;
2. What the users in your area of expertise are prepared to receive?
3. What short-term products/services do you recommend OE developing/offering?
4. What long-term products/services do you recommend OE developing/offering?
5. Are there partnerships/collaborations that are unique to unfolding any of these recommendations that you might suggest?
6. What unique career or STEM opportunities reside within your area of expertise in relation to this effort?
7. What might be some indicators of success for any or all of your recommendations?

Real-Time Data Use
Facilitator: Liesl Hotaling; Rappateur: Susan Gottfried

New Media/Virtual Environments
Facilitator: Peter Tuddenham ; Rappateur: Joe Flood

1. What informal, higher ed, and UR/US users want to achieve and;
2. What the informal, higher ed, UR/US users are prepared to receive?
3. What short-term products/services do you recommend OE developing/offering for these groups?
4. What long-term products/services do you recommend OE developing/offering for these groups?
5. Are there partnerships/collaborations that are unique to unfolding any of these recommendations that you might suggest?
6. What unique career or STEM opportunities reside within your area of expertise in relation to this effort?
7. What might be some indicators of success for any or all of your recommendations?

EXPLORE

Ocean Literacy Principle #7
The Ocean is Largely Unexplored

Essential Concepts

a) The ocean is the last and largest unexplored place on Earth— **less than 5% of it has been explored**. This is **the great frontier for the next generation's explorers and researchers**, where they will find **great opportunities for inquiry and investigation**.

b) Understanding the ocean is more than a matter of curiosity. **Exploration, inquiry and study are required to better understand ocean systems and processes.**

c) Over the last 40 years, use of ocean resources has increased significantly, therefore the **future sustainability of ocean resources depends on our understanding of** those **resources and their potential and limitations.**

d) **New technologies, sensors and tools are expanding our ability to explore the ocean.** Ocean scientists are relying more and more on satellites, drifters, buoys, subsea observatories and unmanned submersibles.

e) **Use of mathematical models is now an essential part of ocean sciences.** Models help us understand the complexity of the ocean and of its interaction with Earth's climate. They process observations and help describe the interactions among systems.

f) **Ocean exploration is truly interdisciplinary.** It requires close collaboration among biologists, chemists, climatologists, computer programmers, engineers, geologists, meteorologists, and physicists, and new ways of thinking.

KEY POINTS STAFF CAUGHT IN DISCUSSIONS

Brainstorming for "Reaching Out in New Ways":

- Reaching out in new ways = new audiences, new partners
  Industry, Community colleges, within NOAA- with other divisions

- New media bringing together intergenerational groups
  Consider different way to calibrate learning moments

- Social learning vs. just presentations- TRUE engagement either in real time or virtually =
  deep, rich and transformative

- Short animated films –series in Second Life
  Fictional – showing what the ship is going to do; cast of characters; technology…
  Follow core of explorers
  Social media – some characters could have Facebook page
  This is how today's youth communicates

- Post things on You-Tube

- Non-tech- EX music group

- CoML –video for You-Tube; VERY popular 3 minute film

- Serious games with decision making tools incorporated

- Something captivating that is not tech-based.
  Consider mainstream TV as valuable resource to hit main stream audience.
  Don't only rely on tech. EQUITY IN ACCESS!

- Freedom so learner is doing the discovery – how do we do this?
  The learner must be actively engaged. Exploration lends itself to this.

- Resource kit for schools – get sent to them to bring in the real world; CD ROM or
  tangible items for use for those that don't have regular internet access.

- How do we convince people that they ARE stakeholders?
  Be sure they know WHY this is critical.
  PR/Marketing Strategy = increased awareness.

- Not one subject Dave has not utilized from HS for his job as ROV lead.
  EVERY TIME ship goes out there is a lesson.

- New audiences through non-science avenues.
  Interdisciplinary ideas – film, art, literature, music, etc.

- How do you reach rural Montana? Must speak to them, must give them the tools.

- Involve industry and corporations.
  How do you convince the corporation that this is important to student education? Speak up to the corporations across the country to provide the tools to the school system.
  Underprivileged – get the corporations involved.
  Laptops for each student…
  Can't accept that they are "behind the curve".

- Independent learning communities.

- Competitions – competitive instincts. Also extends to community learning.

- Designing experiments – interacting with scientists.

- Environmental engagement is big right now– get a hero involved. Ex. Michael Phelps – Olympic swimmer. Kids don't identify with the Cousteau family.

Conversation during Presentations/Working Groups:

- Remember research on learning when developing and using technology.

- Translating current science for 7th grade and creating online investigations.

- Scientific practice should be touchstone for student investigations.

- Develop sustained inquiry experiences students find personally relevant.

- Convene interdisciplinary design research partnership to do the necessary translational work, learning research, and learner-centered design work.

- Use learner-centered software.

- Most promising model – ongoing collaborative partnership between natural scientists, social scientist or education researchers, technologists and education practitioners.

- What resources for self-directed hobbyist groups/self-directed learning can we provide? (dive groups, fish hobbyists, scouts, etc)

- Kids web site.

- Could embed Creatures and Features into the ship on Second Life. – change it to an ROV or control room…

- How much do you do on noaa.gov and how much do you do on other Web sites?

- Need additional resources

- Alliances could become remote command centers – staff to command centers, UR/US, Alliances develop own command centers over time

- Need a sense of urgency, drama about ocean exploration – human health, climate change.

- We need to do a better job of marketing the ship.

- Moving to a different level of how science is done.

From Forum wrap up:
- EX will cover all four goals for the Ocean Hall.

- Temp exhibits on explorations; high definition displays from ROV – share with Alliances

- Get on the news/weather.

- Key is messaging.

- Could we develop an index for the oceans? Something to brand a mission.

- Need sense of ownership from the public

- There is an opportunity to take the tools of science and cyber-infrastructure to create exciting displays for public gathering places and schools, connecting people on land with researchers at sea in ways that are authentic and meaningful. Science is increasingly becoming data driven; showing the data and where it came from in interactive, real-time applications is a huge challenge and can only be done in collaboration with many groups of diverse backgrounds.