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Professional Societies Begin Ocean Science K–12 Education Collaboration

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ABSTRACT. Representatives from 10 professional societies convened at Shannon Point Marine Center, Western Washington University, in August 2008 to identify ways for scientific and educational professional societies to collaborate and provide more effective outreach in K–12 ocean science education. Participating organizations included scientific societies with minor or nonexistent K–12 education efforts, disciplinary-based societies with programs focused in specific K–12 areas, and education-based societies whose primary focus is education and outreach. Workshop participants developed and addressed three objectives: (1) identify what it means for the public/K–12 to understand the science discipline of each society, (2) define appropriate target audiences and how to engage membership and leadership, and (3) identify mechanisms for bringing educators and scientists together. Expanding outreach to members of underrepresented and underserved groups and to students in pre-service teacher training programs were recognized as important cross-cutting themes. Future actions were identified for each objective, and a vision statement was developed.

INTRODUCTION

Ocean scientists are often tapped to provide expertise in content- and inquiry-knowledge and to contribute to K–12 science education. On a larger scale, ocean science professional societies can (and many do) play a key role in linking scientists and the K–12 enterprise by engaging and supporting scientists to work with K–12 educators and students. Most ocean-society-based education activities take place at annual meetings and consist of educationally focused oral and poster sessions as well as specialized workshops for K–12 educators and students where interaction with scientists is a key element. The Geosciences Information For Teachers (GIFT) program at the annual fall meeting of the American Geophysical Union (AGU) is an example of a workshop for professional development of teachers. Presentations and workshops at recent meetings also focused on professional development for scientist members and their graduate students, providing them with a deeper understanding of how they might contribute to teacher preparation and professional development. An example of this approach is the American Society of Limnology and Oceanography (ASLO)-sponsored ReSciPE workshop where scientists learned how to support teachers in inquiry-based science education. Education activities outside of meetings are less common and include scholarship programs (Marine Technology Society, MTS) and scientist mentoring of educators via distributed networks (American Meteorological Society, AMS). Whether conducted at meetings or in the broader community, society education and outreach activities benefit both scientists and educators by increasing the science content knowledge of the teachers, and giving ocean scientists a more realistic view of the needs and issues faced by teachers and pre-service teachers (Thiery et al., 2008).

Gaps in our knowledge of the impact of existing programs and how professional societies can best contribute to K–12 science education in the future exist because professional societies have developed most of their programs and approaches to K–12 education relatively independently. In addition, societies have not taken full advantage of opportunities to form close partnerships with the emerging "networked initiatives" designed and funded to serve as catalytic links between scientists and educators, such as the National Science Foundation (NSF)'s Centers for Ocean Sciences Education Excellence (COSEE) and

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Table 1. Pre-workshop study questions

1. How does education support the mission of your society (what are the specific benefits)?
2. What is your society doing with respect to K-12 education?
3. What is your society not doing, and what are the roadblocks?
4. What would your society consider to be the most successful K-12 program it has conducted, and why?
5. What does your society identify as key gaps in K-12 education?
6. What unique contributions can your society make to K-12 ocean education?
7. What connections exist between your society and the culture/infrastructure of science education (the level of knowledge of STEM best practices/research in the education group)?
8. What special programs exist in your society to address diversity issues in K-12 education?
9. How might combining resources/programs with other ocean science and education societies help your society meet its K-12 education goals?
10. Are there other questions/issues that we should be asking?

other education networks supported by the National Oceanic and Atmospheric Administration. The 2000 COSEE report recognized the role professional societies have in education: "COSEE should also promote greater 'crossing over' of professional organizations of educators and scientists as a means of 'bridging the gap' and increasing the awareness of COSEE and the fundamental role it can play in connecting educators and scientists in ocean research" (COSEE, 2001).

THE WORKSHOP

A workshop held at Shannon Point Marine Center, Western Washington University, in August 2008 sought to address these issues by bringing together representatives of professional societies to collaborate and develop shared goals for ocean science education. Participating societies represented the full range of engagement in K–12 education, from little or no education involvement to primarily education-focused. A mix of education staff and volunteer/elected/appointed committee representatives attended. With input from society governance, the representatives answered a series of pre-workshop study questions (Table 1). The full text of answers was shared with all participants and used by conference organizers as the basis for creating Table 2.

Although there is considerable variation in organizational size, educational infrastructure, and disciplinary focus, the societies' broad educational goals are remarkably similar (Table 2). To complement the professional society education details in Table 2, Matthew Gilligan, Education Chair of the National Association of Marine Laboratories (NAML), compiled information on NAML's diversity and educational work. Of particular relevance to the cross-cutting themes are the organization's reports on effective strategies for outreach to underrepresented populations and recruitment videos specifically aimed at minority students. Information on programmatic "best practices" can be found in Gilligan et al. (2008).

After a structured session in which representatives of each society spoke about each organization's educational audiences, contributions, and interests, participants divided into three afternoon breakout groups. Each group was tasked with identifying the three most important questions/issues raised by the pre-workshop assignment and by participants at the workshop. At the end of the break-out period, the groups presented their reports, reviewed their findings for convergence and overlap, and agreed to reconfigure the break-out results around three central themes. These themes, plus the diversity cross-cutting theme, form the basis for the recommendations refined on the final day of the workshop and presented in the next section.

WORKSHOP ACCOMPLISHMENTS: VISION AND RECOMMENDATIONS

The Importance of Society Engagement

The overall vision that emerged from the workshop is twofold, relatively simple, and potentially powerful: (1) scientific and educational professional societies should focus more attention on collaborative educational work, and

Table 2. Participating professional societies: Education structure and function

Society	Structure: (1) Size, (2) Scope, (3) Education Infrastructure	Educational Goals	Education Function: Primary Audiences; Main Programmatic Venue	Education Function: Types of Activities
American Geophysical Union (AGU)	(1) Large society: 51,000 members with 5,000 in education interest group. (2) Earth system science, physical and geological science; disciplinary subgroups. (3) 2 staff. Education and human resources committee.	Strengthening the STEM pipeline; diversity; public science literacy.	High school and middle school teachers; high school students; minority students; scientist/educator information sharing. Most work at meetings; some nonmeeting minority work.	Geoscience content for teachers (GIFT workshops). K-12 and diversity programs. Career fairs. Education sessions (both oral and poster). Education award. Links with European educators. Newsletter articles and reports.
American Meteorological Society (AMS)	(1) Large society: 12,000 members; regional chapters. (2) Physical sciences with an emphasis on atmospheric science and meteorology. (3) 10 staff in DC education office; separate scholarship and fellowship office. Two education advisory boards (K–12 and higher education).	Strengthening the STEM pipeline; diversity; public science literacy.	Strategic focus on K–12 teachers and minority faculty. Most work via distributed community teams, the Internet, and publications. Some work at meetings. Graduate and undergraduate student support.	Content delivery via Internet, textbooks, graduate courses. Local Implementation Teams (members, master teachers) support teacher learning. Institutes for teachers and minority faculty. Public Weatherfest outreach. Scholarships and fellowships.
American Society of Limnology and Oceanography (ASLO)	(1) Medium to small society: 4,000 members, 33% international; 16% with education interest. (2) Biological and chemical oceanography; aquatic science. (3) No full-time education staff; one part-time staff with outreach duties. Two committees (undergraduate lectures; education and public outreach).	Strengthening the STEM pipeline; diversity at undergraduate and graduate levels; public understanding.	Faculty; teachers and high school researchers; scientist and educator collaborations; significant minority focus at undergraduate and graduate level. Most work at meetings; some Web work.	Role models, minority mentoring and career focus key part of ASLOMP (ASLO Multicultural Program). Educationally focused oral paper and poster sessions. Occasional workshops for K–12 and informal educators at meetings. Education award.
Coastal and Estuarine Research Federation (CERF)	(1) Small society: 1,800 members. (2) Focus on coastal and estuarine resources; international knowledge; base of experts in coastal and estuarine science. (3) No education staff but three committees (Education, Policy and Public Outreach, International)	Main educational goal is to provide public education on coastal and marine issues.	Members with an interest in education; policymakers. Meeting venue for activities.	Education talks and panels at meetings (GK–12 and other routes for K–12 contribution).
Ecological Society of America (ESA)	(1) Medium society: 10,000 members. (2) Ecology of all sorts (including marine). (3) Four education staff and separate public affairs office. Education and human resources committee.	Goals primarily in the literacy sphere; diverse pipeline goals.	Faculty; recent focus on high school teachers and students. Balance between meetings and community programs. Some Web work.	Ecological content for teaching faculty. Field experiences and professional development for educators and high school students (SEEDs chapters). Digital library.
Marine Technology Society (MTS)	(1) Small society: 2,600 members. (2) Ocean technology and science. Significant industry/non academic membership; regional chapters; student chapters. (3) No full-time education group but 2 staff devote some time; education committee with 200 members; scholarship committee.	Information dissemination; promotion of marine technology pipeline and workforce programs.	Individual students (precollege through graduate); teachers at some meetings if regional focus on education.	Education papers at meetings and in journal. Scholarships for undergraduate and graduate students. Sponsor for Marine Advanced Technology Education Center's remotely operated vehicle competition. Education column in newsletter. Academic program guide (print and online).
National Marine Educators Association (NMEA)	(1) Small society: 1,180 members at national level; regional chapters. (2) Aquatic (marine and freshwater) education. (3) No paid staff; most members are educators.	Ocean literacy major goal; building educator expertise to strengthen education.	Ocean educators (both formal and informal) at multiple levels. Balance between national and regional meetings, Web resources and community-based literacy work.	Development of Ocean Science Literacy Principles. Science overviews at meetings. Member professional development. Links to NSTA traditional knowledge community.
National Science Teachers Association (NSTA)	(1) Large society: 55,000 members. (2) STEM teaching; resources for educators; complicated regional and functional infrastructure. (3) Most members are educators.	Effective STEM education; diversity; public literacy.	Science teachers and administrators. Balance of meetings, publications, workshops, and other resources.	Conferences, publications, workshops, other professional development resources for science teachers. Programs have ocean content but extent hard to measure. NMEA and SACNAS are affiliates.

Table continued next page…

Table 2 continued...

Society	Structure: (1) Size, (2) Scope, (3) Education Infrastructure	Educational Goals	Education Function: Primary Audiences; Main Programmatic Venue	Education Function: Types of Activities
Society for the Advancement of Chicanos & Native Americans in Science (SACNAS)	(1) Medium society: 15,000 members; newly instituted chapters. (2) All sciences; initial biomedical focus. (3) 12 staff; two committees.	Primary focus on diverse pipeline. Mentoring and network building key goals	Direct focus on undergraduate and graduate students; teachers; administrators and other stakeholders. The meeting is the community but there is also E-follow-up; post-conference mentoring.	Role model and professional development focus. Inquiry in various disciplines showcased at conference. Unique use of meetings; all minority groups; broad spectrum workshops
The Oceanography Society (TOS)	(1) Small society: 1,600 members, 19% international. (2) Interdisciplinary ocean science. (3) No education staff but one volunteer council member for education.	Disseminate knowledge; ocean community consensus building.	Members with an interest in education; undergraduate faculty. No programs at meetings; education focus confined to articles in Society publication.	Columns in *Oceanography* magazine on hands-on/lab material and educational challenges. Publication of supplements (COSEE EPO Guide for Scientists, and Hands-On Oceanography) and special issues (e.g., Women in Oceanography).

(2) establishing such partnerships among the professional scientific and educational societies will provide a stronger framework for increasing ocean science literacy and improving the quality of ocean education. A significant impact on K–12 ocean education will ensue if the scientific community is engaged effectively with students, pre-service teachers, and in-service teachers. Communication and collaboration emerged as major guiding principles in virtually every discussion, with transformative engagement with science, technology, engineering, and mathematics (STEM) education the ultimate hoped-for outcome of joint society efforts. Such collaborations must also include assessment of the effectiveness and impact of programs.

Vision Statement

Scientific and educational societies will collaborate to inspire our youth, educate the public, and promote the value of educational activities among science professionals. This transformation in the role of professional societies, through focus on ocean science, will help reestablish a scientifically literate populace that can best address the regional and global challenges of the twenty-first century.

RECOMMENDATIONS ORGANIZED BY THEME

Theme 1. Part A. The Importance of Public and K–12 Understanding of the Science Discipline of Each Society

Consensus Statement. Our societies recognize the collective goal of improving the literacy of the process and practice of science (i.e., how and why is science conducted). Promoting this broader literacy supports the effective cultivation of future scientists, as well as an appreciation of science among the general public.

Recommendations. Societies should:

- Review the existing literacy frameworks (e.g., ocean, climate, earth science) that relate to their disciplines, share them with their membership, and strive to increase awareness and knowledge of key literacy concepts and facts through their education and outreach programs' activities.
- Develop or endorse educational materials and methods that reflect current knowledge of both pre- and in-service professional development and classroom practices (including learning styles, misconceptions, and others).
- Develop or endorse educational materials, methods, and programs that effectively engage underserved and underrepresented populations.

Theme 1. Part B. Connecting Scientific Societies with Cognitive and Social Scientists as well as Education Specialists Who Study How the Public/K–12 Acquires Scientific Knowledge and Understanding

Consensus Statement. Our societies recognize the importance of collaboration with cognitive specialists, social scientists, and educators to determine how best to expand public and K–12 scientific knowledge and understanding and to assess the effectiveness of these efforts.

Recommendation. Societies should collaborate with professional education societies (e.g., NSTA, NMEA) and networks (e.g., COSEE) to leverage complementary resources and expertise.

Theme 2. Engaging Membership and Leadership in Programs for Educational Audiences

Consensus Statement. Our societies recognize the importance of engaging our membership and leadership in promoting a cultural shift to recognize K–12 education and education-related community service as important endeavors (and part of the reward and tenure system).

Recommendations. Society leaders and representatives should:

- Create high visibility for K–12 programs and reinforce the value of education to members who may not already be committed.
- Engage society membership with activities such as articles on education in newsletters and awards at national conferences for student outreach, mentors, teachers, and schools.
- Champion education initiatives through larger associations of society governance, including American Institute of Biological Sciences, Council on Graduate Schools, Council of Engineering and Scientific Society Executives, Council of Scientific Society Presidents, and Council of Environmental Deans and Directors.
- Develop prototype programs, with guidelines and training on how to work with schools.
- Recognize the value of extramural educational activities related to their missions (e.g., after-school programs, informal science education center programs).
- Target their young scientist members—undergraduates and graduate students— to engage in K–12 education, and provide appropriate guided mentorship from senior scientist and postdoctoral members.

The "near peer" approach in the last bullet allows scientists to participate at appropriate levels, and provides the opportunity to create a collaborative scientific family. Young scientists learn to communicate science at all levels, and have the opportunity to touch children's lives (e.g., AGU Exploration Station). Underrepresented K–12 students are also more likely to respond to older student role models than to their scientific elders. Societies, with their wide range of talent and broad member geographic distribution, are excellent sources of potential mentors and can offer young scientists access to teams of individuals. Profiles of scientists should be developed to provide examples of role models for K–12 students and as a tool for mentor-mentee matching. Existing networks and programs should be tapped as a people and resource base (e.g., MentorNet program, SEEDS, GK-12, MSPhDs, ASLOMP, ASTC; see the acronym list with Web information in the box on the next page).

Theme 3. Bringing Educators and Scientists Together: Social Networking

Consensus Statement. Societies should develop a network of educators and scientists by identifying interest groups within societies and promoting communication; holding collaborative workshops within and between education and scientific societies, locally and at national conferences; and developing group networking mechanisms. Recognition and appreciation of collaborative work should be supported by analysis of how these interactions lead to focused actions and measurable outcomes.

Recommendations. Societies should:

- Develop a Web model for networking with a central database for educators and aquatic scientists to connect. The database could include self-registration with demographic essentials; be searchable by location, interest, and availability; and include marketing of the resource to underserved and underrepresented individuals. The database could be promoted by societies and in workshops, and include other resources such as conferences, workshops, curricula, career materials and fairs, and list-serves. Measures of success and evaluation could be built into the database.
- Provide opportunities (sessions/workshops) for both scientists and educators to share and present their efforts at society conferences, with reduced registration rates offered to encourage local attendance.

WORKSHOP FOLLOW-UP AND CURRENT ACTIVITIES

Benefits of the proposed collaborations among societies include increased ocean science literacy for students through development of a unified set of offerings for teacher and pre-service teacher professional development, meaningful engagement of the scientific community with K–12 educators and students, and recruitment of future members to ocean science professions and societies. To sustain the efforts begun at the workshop, continued communication and collaboration through quarterly conference calls and periodic meetings of the Washington, DC-based

participants at professional society headquarters in Washington, DC, have been ongoing. A wiki infrastructure developed by Justine Glynn as a resource for Internet social networking provides for continued collaboration and development of partnerships within the larger group (the Ocean Science Education Collaborative, OSEC).

Stemming from consensus developed in our teleconferences, OSEC has begun to disseminate information and recommendations from the workshop to society leadership and is planning intersociety collaborations at two upcoming conferences: a professional development day for teachers at the Oceans 09 conference in October sponsored by MTS, AMS, NMEA, and COSEE, and a joint COSEE-OSEC educational partnership session at the CERF 2009 annual meeting in Portland, Oregon, in November. OSEC has also formed a working group to compile a draft inventory of existing society resources and programs for K–12 educators that will eventually be expanded into an accessible electronic framework that will also enable societies to share model programs, maximize the efficiency and effectiveness of offerings, and identify gaps. Additional longer-term OSEC goals are to: (1) continue to refine social networking mechanisms to facilitate effective intersociety dialog and communication, (2) initiate research on the effectiveness of society education programs, and (3) identify at least one future transformative collaborative project that is also realistic, given limitations on staff time and funding for education programs within professional societies.

PROGRAM ACRONYMS, TITLES, AND WEB LINKS

ASLOMP: ASLO Multicultural Program. http://www.aslo.org/mas.html

ASTC: Association of Science-Technology Centers. http://www.astc.org

COSEE: Centers for Ocean Sciences Education Excellence. http://www.cosee.net

GIFT: Geoscience Information for Teachers, American Geophysical Union. http://www.agu.org/sci_soc/education/#teachers

GK–12: NSF Graduate STEM Teaching Fellows in K–12 Education. http://www.gk12.org

Literacy Frameworks:
Earth: http://www.earthscienceliteracy.org/
Ocean: http://www.coexploration.org/oceanliteracy/
Climate: http://www.climatescience.gov/Library/Literacy/

MentorNet: the e-Mentoring Network for Diversity in Engineering and Science. http://www.mentornet.net

MSPhDs: Minorities Striving and Pursuing Higher Degrees of Success in Earth System Science. http://www.msphds.org

National Association of Marine Laboratories: http://www.naml.org

National Estuarine Research Reserve system: www.nerrs.noaa.gov/Education/K12Educators.html

ReSciPE workshop: http://www.cires.colorado.edu/education/k12/rescipe/

SEEDS: Strategies for Ecology Education, Diversity and Sustainability, Ecological Society of America. http://www.esa.org/seeds

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