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THE BRIDGE WEB SITE

GROWING AND SUSTAINING PARTNERSHIPS BETWEEN OCEAN SCIENCE AND EDUCATION



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INTRODUCTION

When physicist Tim Berners-Lee and a team of fellow scientists at the European Center for High Energy Physics (CERN) launched the first-ever Web site in 1989, their goal was to make it easier for scientists to access research documents and scientific data (CERN, 2008). In 1998, Virginia Sea Grant educators at the Virginia Institute of Marine Science (VIMS) had a similar goal: to make ocean science educational resources and current research data more accessible to classroom teachers. The Virginia Sea Grant education team took the first step toward accomplishing this goal by launching a Web site of its own, called "Bridge." The name was inspired by the idea of a ship's bridge with a teacher at the helm, navigating "an ocean of marine education data." It also represents a bridge spanning the divide between the education and the

ocean research communities, which is the essence of the Bridge project's mission.

Ten years later, Bridge (<http://www.marine-ed.org/bridge>) is an established and widely known online resource for educators, and for scientists connecting with the education community. The Bridge project is committed to educational excellence. This commitment has been reflected in awards from the National Oceanographic Partnership Program (NOPP) for excellence in partnering (2001), from the Mid-Atlantic Sea Grant Marine Advisory Programs for outreach (2003), and from the National Marine Educators Association (NMEA) for significant contributions to marine education (2004). Its growth and success are due in large part to the strength of the original partnerships that built the project, and which continue to support and expand its efforts. During its 10-year history, Bridge has continued to build partnerships that have broadened Bridge's reach and deepened its impact.

THE NEED

Bridge responds to science educators' need for content and resources to help them teach ocean-related topics and concepts. Among those classroom teachers with science degrees, few have specifically studied ocean science, and marine topics are not usually included in teacher preparation programs. Before the Internet, most teachers relied primarily on the textbooks adopted by their school systems for science content. Many widely used textbooks included little marine science, and professional development opportunities for teachers focusing on marine science were limited. It was challenging for even the most determined teachers to obtain current

marine research information and data suitable for classroom use. The divide between most US classrooms and ocean science was wide.

However, as the twentieth century neared its end, educators' access to scientific information began to improve. The expanding accessibility of the Internet, combined with the launch of thousands of research-based science Web sites sponsored by academia, government, and other research facilities, created an exciting portal to the scientific world. The Bridge project was designed to connect educators directly to this growing resource and, more importantly, to provide them with an efficient and easy-to-use tool to locate specific ocean science Web resources to meet their instructional needs.

THE ORIGINAL PARTNERSHIPS

NOPP originally funded the Bridge project in 1997. Virginia Sea Grant educators at VIMS in Gloucester Point, Virginia, developed the project proposal, and Bridge operations continue to be housed there. Bridge funding has been provided by the National Sea Grant Program since 2002.

NOPP Partners

Bridge originally planned a two-tier framework of Web sites within Bridge: all recipients of NOPP education grants would form an initial group of online collaborators with Bridge, and non-NOPP project Web sites would be added later. Connections were established with the five NOPP education projects, and Bridge quickly moved forward into the larger network of online resources. The relationship with the original NOPP projects was important to Bridge, establishing

links that continue today. NOPP sites were among the first sites featured by Bridge, and they were highlighted through special program announcements and the development of classroom data activities. The NOPP-funded COAST-Pathfinder national project included Bridge workshops and activities, and Bridge staff collaborated with principal investigators of two other NOPP projects, Project Oceanography and Project COAST (Consortium of Oceanographic Activities for Students and Teachers), as authors of "Marine Education for the 21st Century," a paper appearing in the NOPP special issue of *Oceanography* in 2000 (Walker et al., 2000).

NMEA and Sea Grant

A fundamental component of the original Bridge design was the incorporation of two established national partners: NMEA and the Sea Grant Education Network (SGEN). NMEA, a professional organization founded in the late 1970s for marine and aquatic science educators, has approximately 1100 national members plus 17 state and regional chapters and several associated international groups. SGEN is comprised of the educators who work for the 30 National Oceanic and Atmospheric Administration (NOAA) Sea Grant College programs located in every coastal and Great Lakes state and Puerto Rico. NMEA and SGEN have always been closely aligned, sharing the goals of building, supporting, and conducting marine education at local, regional, and national levels decades before the concept of "ocean literacy" became a national buzzword. Bridge provides both NMEA and SGEN with an efficient, centralized resource to serve their shared

national target audience of K–12 classroom teachers and other educators.

With NMEA and SGEN as founding partners, Bridge was well placed to reach a wide network of scientific and educational expertise, and to quickly establish national visibility. In August 1998, one year after obtaining funding, the Bridge Web site was officially launched at NMEA's annual conference. At this time, it was the only comprehensive educational portal site focused exclusively on bringing ocean science content and current ocean science research to the education community. It was also one of the few sites for educators that provided annotated links to peer-reviewed Web sites, organizing these links in a comprehensive, categorical, content-based scheme. These features made Bridge immediately popular with busy teachers, both those who were experienced Web users and those who were novices at Web searching.

The NMEA partnering network supports communication and activity with teachers and science education organizations nationwide. Bridge maintains the NMEA Web site and shares the NMEA home page address (<http://www.marine-ed.org> and <http://www.marine-ed.org/bridge>), so all visitors to the NMEA site are linked to Bridge. All but one of NMEA's 17 chapters

has a Web site, and these sites also link to the Bridge site. NMEA assists with funding Bridge's teacher-centered Web site review process, described later in this article. Bridge staff are active NMEA members and participate in NMEA board and committee activities, exhibit at NMEA outreach events, and contribute articles to *NMEA News* and to NMEA's peer-reviewed journal *Current* on a regular basis.

Initially, the Bridge project also maintained the SGEN Web site (<http://www.seagranted.net>), which connected visitors to Bridge as well as to the education sections of each Sea Grant College Program Web site. Management of the SGEN site has since been transferred to the Maryland Sea Grant Program, but the site links to Bridge, and SGEN online resources are catalogued in the Bridge database.

The SGEN partnership brought a valuable regional component to the early years of the Bridge project. Four Regional Coordinators (RCs), each one an experienced Sea Grant educator, were original Bridge partners: Vicki Osis from Oregon Sea Grant (Pacific RC), Rosanne Fortner from Ohio Sea Grant (Great Lakes RC), Sharon Walker from Mississippi/Alabama Sea Grant (Gulf of Mexico RC), and Terri Kirby Hathaway from North Carolina Sea Grant (Atlantic RC). The

RCs conducted some of the first dissemination workshops for Bridge, and they helped create and maintain four regional Bridge Web pages. Additional RCs were added over time, including Jean May-Brett, currently with the Louisiana Department of Education and a former NMEA president, who serves as a Bridge liaison to the National Science Teachers Association. The leadership exhibited by these educators, and their face-to-face connections with educators in their regions, were critical to the initial development and dissemination of the project. Although funding cuts later reduced the support available for regional Bridge activities, most of the RCs continue to identify with and support Bridge through outreach activities, and they act as ad hoc project advisors.

SCIENTISTS AND BRIDGE

Because ocean research data are key elements of Bridge's resources, scientific accuracy of the Web sites included in the Bridge database is a priority. Bridge staff members, all with strong marine science backgrounds, serve as first-level science reviewers of sites under consideration for Bridge. A volunteer group of scientists (Scientific and Technical Advisory Reviewers, or STARs) provide additional scientific review if a site contains information beyond the scope of Bridge staff expertise, or if there is a particular detail that causes concern.

Over the past decade, scientists have become much more actively involved in sharing their science with students, teachers, and other nonscientists. Many granting agencies now encourage scientists to include public education as a "broader impact" component in research proposals. Research-based information

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and data are key elements of Bridge's appeal to science educators. Bridge facilitates the needs of both groups by helping researchers make their data available and useful to educators nationwide. Bridge staff also advise researchers on effective Web design, data display, and data interpretation strategies for the education community.

Bridge staff regularly partner on an in-depth basis with scientists to develop instructional materials called DATA, or "Data Analysis Teaching Activities" (<http://www2.vims.edu/bridge/search/archives.cfm>). These classroom-ready activities incorporate a scientific data set into an inquiry-based lesson for students and include analysis and interpretation for the teacher. There are currently 69 DATA archived on Bridge, and new ones are under development. Topics cover a broad range. Collaborating scientists are primarily from government and academic research institutions, including the National Marine Fisheries Service, US Army Corps of Engineers, National Weather Service, National Data Buoy Center, NOAA Marine Sanctuaries, VIMS, and the Monterey Bay Aquarium Research Institute. Currently, Bridge staff are developing instructional materials with a marine biologist studying deep-sea habitats, as well as with scientists using ocean observing systems in their research.

Ocean observing science has emerged as a strong source of partnerships for Bridge. Bridge contributed to some of the first national conferences focusing on integrating education into ocean observing initiatives. Bridge staff members have supported the inclusion of education into ocean observing science activities in several significant ways:

- authored a white paper for the 2004 NSF Ocean Research Interactive Observatory Networks (ORION) conference in San Juan, Puerto Rico
- participated in the ORION Education Working Group to develop recommendations on education within the ORION project (ORION, 2004)
- joined the Sea Grant Integrated Ocean Observing System workgroup in 2004 to develop recommendations to the National Sea Grant Office for Sea Grant involvement in the national ocean observing effort
- participated in Ocean.US Integrated Ocean Observing System education activities
- serving as education liaison to the Mid-Atlantic Coastal Ocean Observing Regional Association (MACOORA) and to the Chesapeake Bay Observing System (CBOS)
- working with the COSEE NOW (Centers for Ocean Sciences Education Excellence Networked Ocean World) project

A special ocean observing system (OOS) section of Bridge includes background on the science and technology of ocean observing, links to OOS Web sites, and teaching activities using OOS data.

CLASSROOM TEACHERS AND BRIDGE

Since 1992, the Bridge TROLLs (Teacher Reviewers of On-Line Learning) have been a vital component of the Bridge

team. These individuals volunteer hundreds of hours to review Web sites, using a rubric focusing on site elements that assure content accuracy and usefulness in the classroom. Anyone may nominate a Web site for Bridge using an online form. Bridge staff and at least one teacher volunteer review the site. Only those sites with high ratings are added to the Bridge database. TROLLs not only provide invaluable assistance to the project, but they also build their personal scientific knowledge through the review process and become part of a close professional network.

Over 89 educators from around the globe have signed up for the TROLL program. Currently, there are 15 teachers serving as active TROLLs, six of whom have been volunteering since the TROLL program began. Incentives for TROLL service are provided through funds from NMEA. These incentives include Bridge logo items (e.g., caps, lab aprons, laptop bags) as well as partial support for costs of participation in the NMEA annual conference. However, the most active TROLLs have continued their service long after earning all incentives, and have taken a personal ownership in Bridge, which contributes to the sustainability and credibility of the project. These TROLLs provide vital dissemination services for Bridge, introducing the Web site to their colleagues at school as well as at local, regional, and national education workshops and conferences.

Know of an outstanding ocean science education resource that should be on Bridge?

Nominate it at <http://www.marine-ed.org/bridge/nomination.html>.

Visitors to Bridge can find resources and activities on these topics and many more!

- Plate Tectonics
 - Ocean Sediments
 - Coastal Erosion
 - Pollution
 - Climate
 - Physical Sciences
 - Plankton
 - Blue Crabs
 - Mollusks
 - Sea Turtles
 - Marine Mammals
 - Ocean Science Careers
-

Their outreach efforts may be the most significant of all Bridge's dissemination strategies, because—as experienced users of Bridge resources—they provide an endorsement that is trusted and acknowledged by other teachers.

A COMMUNITY OF EDUCATORS AND SCIENTISTS: SCUTTLEBUTT

One of the most powerful, successful, and popular elements of the NMEA-Sea Grant-Bridge partnership is the daily communication tool provided by “Scuttlebutt,” the email discussion list hosted and maintained by Bridge. Scuttlebutt was one of the first discussion lists (if not the first) devoted exclusively to ocean science education. Scuttlebutt is a convenient and controlled forum for educators to connect with colleagues and scientists. There are currently 1,300 individuals subscribed to the list. Discussions focus on ocean science research, teaching strategies and lessons, as well as announcements of new projects, conferences, and other professional development opportunities. Classroom teachers who may not otherwise have any direct access to the scientific community ask questions about marine science topics

and receive answers, sometimes in a matter of minutes, from experts in the field. To subscribe, go to: <http://www.marine-ed.org/bridge/scuttle.html>.

COSEE PARTNERSHIPS

Bridge has been an active participant in NSF's COSEE project since its beginning. The COSEE program responds to the national need for cooperation between the research and the education communities in the delivery of quality marine education resources and opportunities nationwide (<http://www.cosee.net>). Bridge staff participated in the May 2000 NSF workshop that explored the idea of a nationally coordinated ocean science education effort. The NSF COSEE program was developed based on recommendations following this event. In 2002, Bridge, the Consortium for Oceanographic Research and Education (CORE), the National Sea Grant Office, and the University of South Carolina Office of Program Evaluation submitted a collaborative proposal to develop the COSEE Central Coordinating Office (CCO). Bridge had several roles in the CCO project from 2002 through 2007, including connecting the entire COSEE system with Bridge's collection of online

reviewed ocean education materials, and coordinating both the development of the COSEE online network and the management of COSEE's informational resources. The latter role led directly to another, more technical partnership, working with the Digital Library for Earth Systems Education (DLESE) to structure metadata for Bridge and COSEE resources in order to make them retrievable via consistent protocols and discoverable to broad audiences. (See following section for more on DLESE.)

Bridge staff members are currently active partners in the recently funded “COSEE Networked Ocean World” (COSEE NOW), helping to develop an online ocean education community focusing on ocean observing systems and the use of OOS data in teaching activities. Bridge staff are also working with COSEE California to develop a “Communicating Ocean Sciences” course for graduate students at VIMS.

DLESE AND BRIDGE

In early 2004, Bridge began its collaboration with DLESE (<http://www.dlese.org>), an NSF project. DLESE was designed with a goal similar to that of Bridge: to provide a comprehensive online source of pedagogically sound, scientifically accurate resources and data sets. However, where Bridge focused on ocean sciences, DLESE covered the entire realm of the geosciences. The Bridge-DLESE collaboration formed a productive partnership: Bridge helped DLESE grow by contributing an existing collection of reviewed ocean education resources along with an established national audience of educators, and DLESE provided Bridge with a presence on two national science education online libraries—DLESE and

the National Science Digital Library (NSDL). Bridge staff worked with DLESE technical staff to develop protocols for updating and expanding Bridge's existing resource metadata to align with the established DLESE structure. This work required a complete re-review of all 1,000+ Bridge resources. While Bridge tackled the resource metadata, DLESE programmers developed a more robust search engine design, a great improvement upon Bridge's previous simple structure. The latest Bridge engine, inspired by the DLESE model, searches the metadata records to match search terms to several categories, including title, description, and keywords, and then displays the results in ranked order by relevance. Bridge staff built special resource collections for both the NOAA Office of Education and COSEE. Bridge and COSEE collections were both incorporated into DLESE in early 2006. The Bridge-NOAA collection was accessioned to DLESE in 2007.

NOAA EDUCATION AND BRIDGE

NOAA has developed an extensive suite of ocean education products and resources with origins in many different NOAA programs. During 2006–2007, Bridge completed a project with NOAA's Office of Education to create a Bridge-based NOAA portal site. This portal makes NOAA's resources more visible to Bridge's 300,000+ annual users, introducing them to the wealth of information and data available from NOAA offices (see <http://www2.vims.edu/bridge/noaa>.)

The NOAA collection is searchable by keyword, grade level, resource type, NOAA mission goal relevance, and other criteria. Over 75 NOAA entities

are represented on Bridge, there are links to over 150 NOAA data products, and 26 original Bridge-authored DATA lesson plans are built on NOAA data. Bridge staff have reviewed and accessioned over 160 NOAA resources. As new NOAA education resources become available, Bridge staff review, catalog, and incorporate them.


The NOAA community also uses Bridge as a communications tool to disseminate project information to educators via announcements of news and events on the Scuttlebutt listserv and the Bridge home page. NOAA's National Marine Protected Areas' monthly email newsletter "Information Exchange" is a regular feature on the Bridge home page.

CONCLUSION

There have been huge changes in educators' use of online resources since Bridge was launched in 1998, and they are transforming teaching and learning practices. According to the National Center for Education Statistics, by 2005 more than 99.5% of US public schools had Internet access. K–12 classrooms with Internet access had risen from 3% in 1994 to 94% in 2005, and on average one computer for every four students in a school provided Internet access (US Department of Education, 2006). Usage statistics for the Bridge Web site have increased steadily over its first decade, from a monthly average of 3,250 visits during the 1999 school year (the first full year after Bridge was introduced), to the recent school year average of 26,000 visitors monthly. In 2007, almost one million pages were accessed during over 322,000 visits to the site. The Microsoft Network lists more than 7,000 sites linking to Bridge.

The number of education sites on the Web has mushroomed, creating a growth market in commercial and noncommercial Web sites that attempt to identify and organize information resources for the education community. In spite of the proliferation of education portal sites, Bridge maintains a unique position, due to its focus on ocean sciences, its promotion and facilitation of educators' use of online scientific data, and most importantly, its active, involved, long-term partnerships with members of both the education and scientific research communities.

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