

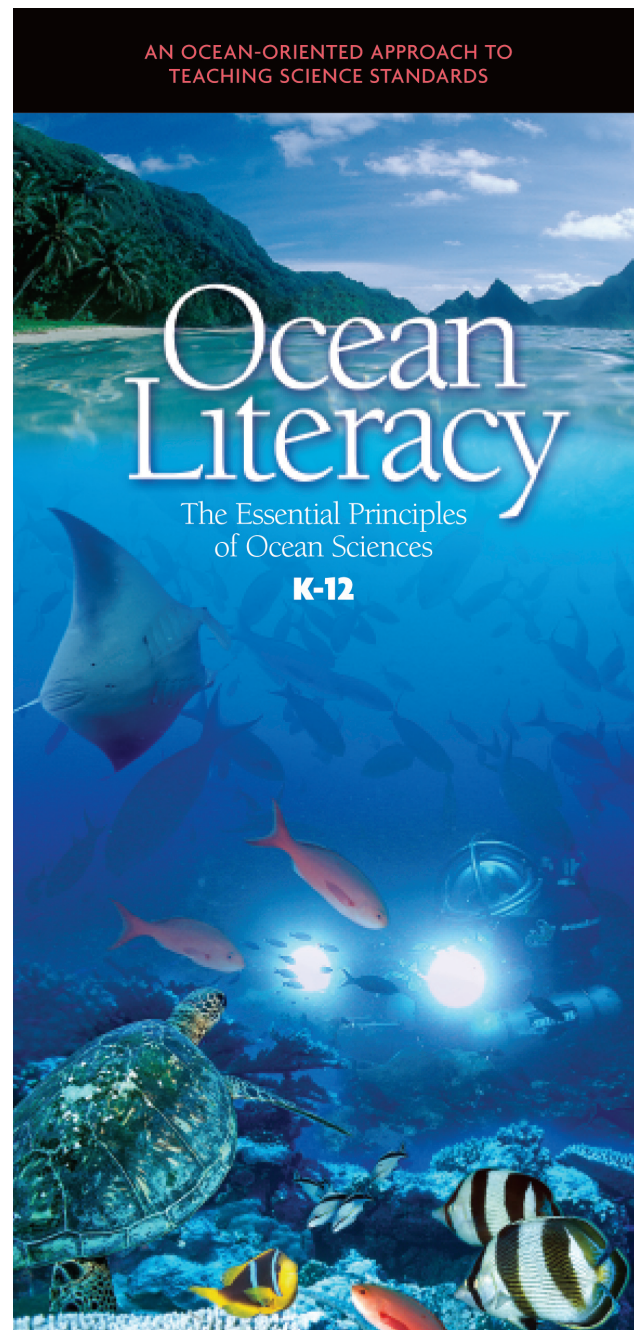
## FROM THE PRINCIPLES TO THE SCOPE AND SEQUENCE: A BRIEF HISTORY OF THE OCEAN LITERACY CAMPAIGN

BY SARAH SCHOEDINGER, LYNN UYEN TRAN, AND LYNN WHITLEY

The Ocean Literacy Campaign is a wide-ranging, collaborative and de-centralized effort by scientists and educators to create a more ocean literate society. An important component of the Campaign is the education of our K-12 students in ocean sciences. The development of two consensus documents, *Ocean Literacy: The Essential Principles of Ocean Sciences K-12* (hereafter referred to as the Ocean Literacy Principles) and the complementary *Ocean Literacy Scope and Sequence for Grades K-12* (hereafter referred to as the Scope and Sequence), has been integral to this Campaign. The documents provide formal and informal educators and curriculum and program developers with a “roadmap” that helps them build coherent and conceptually sound learning experiences for students from Kindergarten through 12th grade. Over the years, the efforts in the Campaign have been, and continue to be, supported by many organizations and the dedicated individuals within them. In this discussion, we offer a compressed historical overview of the development of the two consensus documents to chronicle the collective endeavor of a committed community, as well as acknowledge all those who have contributed to making this ground-breaking work a success.

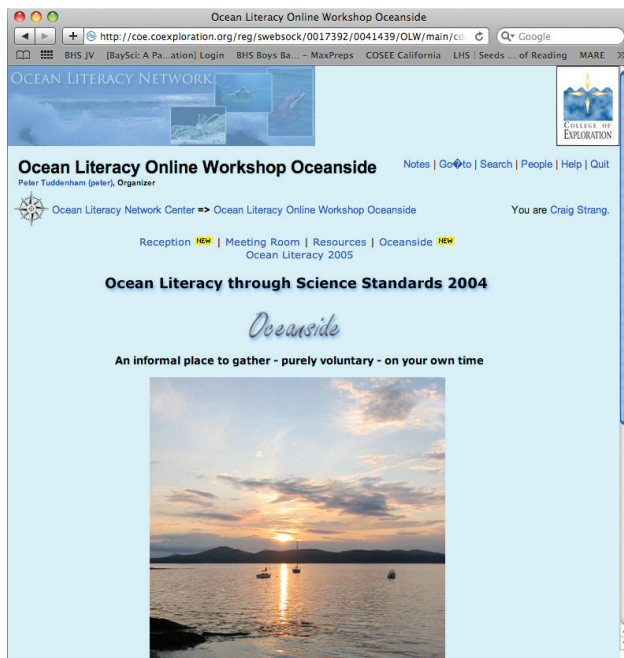
To begin, why did we need to develop a definition of, and identify essential principles and fundamental concepts for, ocean literacy? When the *National Science Education Standards* was published in 1996<sup>1</sup>, members of the ocean sciences and ocean education communities were dismayed to find that there was little mention of ocean topics in the content standards. Additionally, most state standards did not include much about the ocean, coasts, or watersheds. Consequently, the teaching of ocean sciences was largely ignored in most K-12 classrooms. There were exceptions of course; pockets of excellence, where passionate educators and innovative programs managed to bring marine science content and experiences to some students. Without a coherent framework of concepts and messages, however, ocean educators and scientists began to realize that these topics would remain on the margins of teaching and learning about science. Additionally, there was a conviction among educators and scientists that the ocean provided an exciting context for teaching science and other disciplines in an integrated manner. Nevertheless, without consensus on what was important for people to learn about the ocean, we would continue to be hard pressed to make the case to include ocean sciences into national and state standards, and for more teaching about the ocean in K-12 classrooms.

Early works to develop a consensus position on ocean sciences education began in 2002. The College of Exploration and



Cover of *Ocean Literacy: The Essential Principles of Ocean Sciences K-12*.

National Geographic Society (NGS) led an online conference in 2002, *Oceans for Life*, which resulted in the pre-cursor<sup>2</sup> to the work summarized in the Ocean Literacy Principles. Additionally, two high-level commissions identified ocean education as a key strategy for achieving the policy goals identified in their reports.<sup>3,4</sup> It became apparent that without an ocean literate public, we would never solve our most critical ocean resource management issues. In 2003-2004, efforts across several organizations came together in a synergistic way. The Center for Ocean Sciences Education Excellence—New England, led by scientist Bob Chen, identified the concepts thought to be the most important for the public to know about the ocean in their region. The National COSEE Network, led by Craig Strang, Sarah Schoedinger, and Sharon Walker, identified Ocean Literacy to be its top strategic priority. Scientist and member of the National Marine Educators Association (NMEA), Bob Stewart, led seven of his colleagues to write and present a paper, *What Every Student Ought to Know about the Ocean on Graduation from High School*. NMEA, initially led by Elizabeth Day-Miller, Craig Strang, Bob Stewart, and Sarah Schoedinger, established an Ad Hoc Committee on Science Standards to determine how to infuse more ocean-related content into the K-12 curriculum. The NGS, the National Oceanic and Atmospheric Administration (NOAA), National Sea Grant College Program, Lawrence Hall of Science, the College of Exploration, the Ocean Project, and the Association of Zoos and Aquariums (AZA) all lent their ample support to bind these various efforts into a national campaign. The movement was ignited.



Work began on the Ocean Literacy Principles during a two-week, asynchronous, online workshop hosted by the College of Exploration.

In October 2004, the College of Exploration hosted a two-week online workshop, *Ocean Literacy Through Science Standards*, on its virtual campus ([www.coexploration.org](http://www.coexploration.org)) that involved roughly 100 people representing constituencies important to improving ocean literacy. These constituencies included: formal educators (primarily from K-12 schools, but also colleges and universities); researchers from various sub-disciplines of the ocean sciences; education policymakers (from AAAS; NSTA); science coordinators from state and local departments of education; informal educators; and federal agency representatives involved in education and outreach. While some small face-to-face meetings were necessary throughout the process, we found that meeting online supported the inclusiveness, transparency, and democratic process of our work and became a useful tool in our efforts. At the end of this online workshop, we reached consensus on a definition of ocean literacy, and developed a draft set of principles, which were eventually winnowed down to the seven Essential Principles with 44 Fundamental Concepts analogous to those in the National Science Education Standards (NSES).<sup>5,6</sup> Small teams of scientists and educators took this draft and fleshed out the ideas through an iterative process of writing and sending out their revisions for review by members of the ocean sciences education community. The result of their diligence and commitment was the ground-breaking document *Ocean Literacy: The Essential Principles and Fundamental Concepts of Ocean Sciences K-12*, which identifies the content knowledge that an ocean literate person should know by the end of 12th grade.

A matrix aligning the Ocean Literacy Principles to the content standards in the NSES was developed, but it was also recognized that more was needed. Since the *Essential Principles* and *Fundamental Concepts* are ideas students should understand by the *end* of high school, it was difficult for a teacher, curriculum developer, or standards committee to know what to include about a specific ocean concept at a particular grade band that would help students build a complete understanding by the end of 12th grade. It became apparent that a scope and sequence showing how the Ocean Literacy Principles could be taught at various grade bands (K-2, 3-5, 6-8, 9-12) was needed. We decided conceptual flow diagrams would provide the community with a more detailed and useful tool for building an understanding of each concept (for more information and theoretical underpinnings of conceptual flow diagrams, please refer to the article in this report by Craig Strang, Kathy DiRanna, and Jo Topps on page 27).

Work on the Scope and Sequence for Grades K-12 officially began in April 2006. Forty-six scientists and educators from the ocean literacy community and experts in conceptual flow development met at the Lawrence Hall of Science (LHS) at the University of California, Berkeley, hosted by COSEE California and NOAA Office of Education, for three days to conduct the initial development of the Scope and Sequence. They produced early versions of 14 of the 28 flows. From May 2006 to June 2008, members from this initial development team (Rita Bell,

Tina Bishop, Francesca Cava, Beth Jewell, Judy Lemus, Sarah Schoedinger, Craig Strang, Peter Tuddenham, and Lynn Whitley) led numerous working groups across the country. Dozens of educators and scientists participated in all day working meetings, as well as in special workshops held at annual meetings for NMEA and NSTA, to write and discuss the concepts and ideas in each principle that were appropriate for each grade band. These working meetings around the country resulted in a *first draft* of each conceptual flow diagram.

Between June and November 2008, marine educators and curriculum developers at LHS/COSEE California along with ocean scientists and educators from the ocean literacy community revised the first draft of each conceptual flow diagram. Coordinated by Lynn Tran, the LHS team included Noelle Apostol, Emily Griffen, Catherine Halversen, Sarah Pedemonte, Craig Strang, Emily Weiss, and Maia Wilcox with additional assistance from Frannie Coopersmith, John Farrington, Myrna Jacobson, David Mountain, Adina Paytan, Gil Rosenthal, Bob Stewart, and Tammie Visintainer. The LHS team worked in groups of two to five individuals, in two-hour sessions, two to three times each week. Addressing each conceptual flow diagram individually, they clarified concept statements; organized and reorganized concepts; and elaborated, expanded, and further broke down the concepts identified in the first draft. They also consulted with scientists and educators in the community. This revision resulted in a *second draft* of the flows.

A two week, online *Public Review* took place from November 5-19, 2008. Members of the ocean literacy community were invited to participate in the review of the second draft of the Scope and Sequence, which comprised of 28 conceptual flow diagrams. As before, the review occurred on the virtual campus of the College of Exploration, and was open to all interested educators and scientists. Over 100 scientists and educators participated using *Caucus Space* for online asynchronous discussions and *Marratech* for synchronous virtual meetings. They scrutinized, debated, discussed, and reworked the content, language, organization, and presentation of all the flows individually. For both the synchronous and the asynchronous online discussions, one scientist and/or one educator moderated the interactions. The team of educators and curriculum developers at LHS/COSEE California spent the next few months amending the second draft of the conceptual flow diagrams in light of the feedback from the Public Review. These modifications were made one principle at a time; that is, the conceptual flow diagrams for grades K-2, 3-5, 6-8, and 9-12 in each principle were reviewed together in order to ensure progression of concepts and consistency in language across all grade bands. This revision resulted in the *third draft*.

Next, from April-June 2009, individuals with specific expertise in ocean sciences and education were invited to take part in the two-stage *Expert Review* of the third draft of the 28 conceptual flow diagrams. Stage one (April-June 2009) was a review of the science content for accuracy. Two to three ocean scientists with

expert knowledge in the particular concepts within a particular principle were selected to review all four grade band conceptual flow diagrams for that principle. The scientists reviewed the flows for scientific accuracy and conceptual logic; the Scope and Sequence project manager facilitated correspondences by tele-conference and email between the scientists in order to resolve disagreements and inconsistencies. The third draft of the flows was revised in accordance with suggestions from the scientists. Stage two (June 8-10, 2009) was a review for educational appropriateness of the content. Fourteen educators with expertise in conceptual flow diagrams, the Ocean Literacy Principles, classroom teaching, curriculum development, and educational research convened at LHS to scrutinize and modify the flows for accuracy as conceptual flow diagrams and their developmental appropriateness and progression without changing the scientific integrity of the statements. The educators formed teams of three to four individuals with different expert knowledge, and each team discussed and revised all four grade band conceptual flow diagrams for a particular principle. They also reviewed the conceptual flow diagrams within each grade band, across all seven principles. The team of educators and curriculum developers at LHS/COSEE California spent the next month incorporating all feedback from both Expert Reviews into a *fourth draft* in time to be showcased at the 2009 NMEA Conference in Monterey, California.



Beth Jewell, Peter Tuddenham, Lynn Whitley, Maia Wilcox, and Tammie Visintainer toasting the completion of the Scope and Sequence following the Expert Educator Review in Berkeley, California.

Craig Strang, Lynn Tran, and Lynn Whitley launched the entire *Ocean Literacy Scope and Sequence for Grades K-12* in a day-long, pre-conference workshop at the NMEA Conference in June 2009. The workshop explored the design of professional development related to the Scope and Sequence and was attended by 40 enthusiastic participants. At the same time, COSEE California, led by the College of Exploration (Scott Carley, Peter Tuddenham, Tina Bishop, and Scott Tuddenham) has been re-designing the Ocean Literacy website (<http://www.oceanliteracy.net>) to make the complete Scope and Sequence available online. The new website should be launched by the time you receive this NMEA Special Report.

2002	2003	2004	2005
<p>Ocean literacy discussions initiated.</p> <p>→ College of Exploration and National Geographic host <i>Oceans for Life</i> online conference.</p>	<p>NMEA establishes Ad Hoc Committee on Science Standards.</p>	<p>National COSEE Network makes Ocean Literacy top strategic priority.</p> <p><u>October</u>. Online Ocean Literacy workshop.</p> <p>→ National Geographic Society, COSEE, NOAA, NMEA, and the College of Exploration host online conference.</p> <p>→ Initial set of key concepts identified.</p>	<p><u>February-July</u>. <i>Ocean Literacy: The Essential Principles of Ocean Literacy K-12</i> developed.</p> <p>→ Iterative process through public online and in-person meetings to refine concepts.</p> <p>→ Matrix to align the Ocean Literacy Principles and concepts with the National Science Education Standards (NSES).</p>
2006	2007	2008	2008
<p><u>April</u>. Work on Scope and Sequence begins.</p> <p>→ Working meeting at Lawrence Hall of Science results in early versions of 14 conceptual flow diagrams.</p> <p><u>May (to June 2008)</u>. First draft of Scope and Sequence developed.</p> <p>→ Working meetings at workshops and national conferences around country, including University of California and MAMEA Conference in Maryland, result in first draft of all 28 conceptual flow diagrams.</p>	<p><u>July</u>. Public review of Scope and Sequence Grades K-5 at NMEA Conference in New York City.</p>	<p><u>June-July</u>. Public review of Scope and Sequence.</p> <p>→ Review of Grades 6-12 at NMEA Conference in Savannah, Georgia.</p> <p>→ COSEE West Teacher Workshop.</p>	<p><u>June-November</u>. Second draft of Scope and Sequence developed.</p> <p>→ Working meetings at the Lawrence Hall of Science, with scientists and educators.</p> <p><u>November</u>. Online Public Review of second draft.</p>
2009	2009	2009	2010
<p><u>January-April</u>. Third draft of Scope and Sequence developed.</p> <p>→ Working meetings with scientists and educators to incorporate feedback from Online Public Review.</p> <p><u>April-June</u>. Expert Review of third draft.</p> <p>→ Stage 1, Scientists review</p> <p>→ Stage 2, Educators review</p>	<p><u>June</u>. Fourth draft of Scope and Sequence developed.</p> <p>→ Working meetings with scientists and educators to incorporate feedback from Expert Reviews.</p> <p><u>June</u>. Launch of complete Scope and Sequence.</p> <p>→ Pre-conference rollout and professional development workshop at NMEA Annual Meeting in Monterey, CA.</p>	<p><u>July-September</u>. Final edits of Scope and Sequence made.</p> <p>→ Working meetings at the Lawrence Hall of Science to refine layout and design of conceptual flow diagrams and, ensure alignment to <i>Ocean Literacy Essential Principles and Fundamental Concepts</i>.</p> <p><u>Fall</u>. Launch of updated Ocean Literacy website with online version of Scope and Sequence.</p>	<p><u>Winter</u>. Publication of the NMEA Special Report #3 on the Ocean Literacy Campaign featuring the <i>Ocean Literacy Scope and Sequence for Grades K-12</i>.</p>

Table 1. Chronology of major events for developing the Ocean Literacy Framework.



Participants engage in small group discussions at the pre-conference Professional Development Workshop at the NMEA Annual Conference in Monterey, California.

From July–October 2009, the LHS/COSEE California team made the last revisions for the *final draft* of the Scope and Sequence. These revisions included: editing the layout and design for all the flows based on informal feedback from participants at the NMEA pre-conference workshop; reviewing the flows by grade bands to identify cross-references between principles; and scrutinizing the flows individually to determine alignment with the Ocean Literacy Principles. This alignment matrix is part of the supporting materials in this NMEA Special Report.

Together, the *Ocean Literacy: The Essential Principles of Ocean Sciences K-12* and the complementary *Ocean Literacy Scope and Sequence for Grades K-12* documents make up the *Ocean Literacy Framework*. As evidenced by this compressed chronology of events, the making of the Ocean Literacy Framework has been a massive collaborative and iterative undertaking that has involved hundreds of dedicated people who gave generously of their usually uncompensated time, energy, and expertise—a testament to this remarkable community. See Table 1 for



Tides, waves and predation cause vertical zonation patterns along the shore, influencing the distribution and diversity of organisms (Principle 5h).

a summary of the major events. It is also important to point out that many efforts within the Ocean Literacy Campaign would not be possible without the willingness of large numbers of people with diverse opinions from numerous organizations to come to consensus on some very important decisions related to the substance of ocean literacy. Why is this so amazing? Because the Ocean Literacy Campaign has been, and continues to be, a grass-roots effort by ocean scientists, science educators (formal and informal), education policy makers, and others who have been able to put aside their personal and agency-specific agendas along with their need for recognition in order to stay focused on fostering an ocean literate society. Moreover, numerous other accomplishments inside and outside the ocean sciences community have emerged from these efforts and collaborative activities (for more information on these impacts, please refer to the *Impacts of the Ocean Literacy Principles* in this NMEA Special Report). There are many individuals who have contributed to this effort since 2002, as well as organizations that played a significant leadership role in the development of the Ocean Literacy Framework. Look to the “Honor Roll” for a list of all those who have contributed their time, expertise, and good will, much of it voluntarily, to make the Scope and Sequence. To each of you, we extend our sincere appreciation.

#### ENDNOTES

- 1 National Research Council. (1996). *National Science Education Standards*. National Academy Press: Washington, D.C.
- 2 The scope and sequence that resulted from the Oceans for Life conference is available at <http://www.nationalgeographic.com/seas/>
- 3 U.S. Commission on Ocean Policy, *An Ocean Blueprint for the 21st Century. Final Report*. Washington, DC: <http://www.oceancommission.gov>, 2004, p.122.
- 4 Pew Oceans Commission, *America's Living Oceans: Charting a Course for Sea Change. A Report to the Nation*. Arlington, VA: <http://www.pewoceans.org>, 2003, p. ix.
- 5 *Ocean Literacy Essential Principles and Fundamental Concepts for K-12*, [http://www.coexploration.org/oceanliteracy/documents/OceanLitConcepts\\_10.11.05.pdf](http://www.coexploration.org/oceanliteracy/documents/OceanLitConcepts_10.11.05.pdf)
- 6 Cava, Francesca, S. Schoedinger, C. Strang, and P. Tuddenham. (2005). *Science Content and Standards for Ocean Literacy: A Report on Ocean Literacy*, [http://www.coexploration.org/oceanliteracy/documents/OLit2004-05\\_Final\\_Report.pdf](http://www.coexploration.org/oceanliteracy/documents/OLit2004-05_Final_Report.pdf)