Preparing Educators with Practical Science: Ocean Observing in the Classroom

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Abstract – Over the past two years, the UNH Coastal Observing Center and the Gulf of Maine Ocean Observing System (GoMOOS) have co-sponsored two week-long teacher workshops that offer curriculum content and hands-on experience in using ocean observation data as a successful teaching tool in the classroom. Teachers ranging from grammar school to high school levels worked to create practical lessons that incorporate ocean observing data into their current classroom settings and are using it today. This paper will explain what teachers have been learning in the UNH/GoMOOS summer Educator Institutes and how they have been using ocean observing data in their classrooms.

I. INTRODUCTION

Scientists have been observing the ocean for centuries using a wide variety of tools. Today we have the ability to monitor the ocean on a continuous basis and in some places collect data as frequent as every 15 minutes or less, 7 days a week. In coastal zones around the United States, and in the Great Lakes, scientists are working with federal and state agencies to set up oceanographic monitoring stations on, near and off shore that will collect thousands of gigabytes of data to answer critical questions about how the marine environment works. What is fascinating is that teachers, fishermen, and the interested public have access to these large oceanographic data sets, but without necessary training, these data will go untouched by this audience.

The Gulf of Maine Ocean Observing System and the UNH Center for Coastal Observing are two of many ocean observing organizations that are dedicated to education and outreach in the ocean observing field. Through teacher trainings, useful classroom resources, on-line tutorials, continual teacher collaboration, and much more, we have been preparing educators with methods to use and integrate practical ocean science into their curricula. This paper explains how our past two teacher workshops were set up, why we feel the process has been well received, and why the call for more outreach about the importance of protecting and studying our oceans is so important.

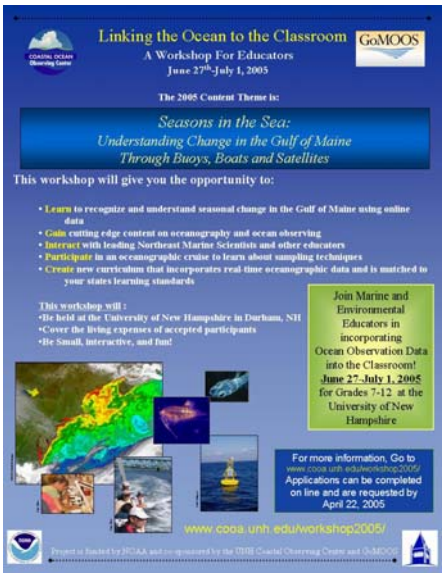
2005 Ocean Observing Educator Institute aboard the R/V Gulf Challenger

II. TEACHER WORKSHOPS

A. Why offer teacher workshops?

For years, educators have sought to prepare their students with skills and knowledge needed to contribute positively to a world with many unsolved questions. Many educational reform efforts phrase this type of preparation as the need to become science or ocean

literate [1]. The U.S. Commission on Ocean Policy as well as the Pew Oceans Report also support the philosophy that students need to learn science and technology by being exposed and connected to scientists and their research [2, 3]. With real/near-real-time data, current environmental case studies, and access to new web-based tools, students and teachers can participate in science in a brand new way. By leading extended professional-development workshops using ocean observing data we are helping teachers "deepen their content knowledge and learn new methods of teaching" while gaining an authentic learning experience [4].



2005 workshop advertisement sent through the web, to schools and to marine science associations.

B. How have we run them?

The past two 5-day Ocean Observing Educator Institutes held at the University of New Hampshire and co-sponsored by the Coastal Observing Center of UNH and the Gulf of Maine Ocean Observing System (GoMOOS) were planned with a thematic focus around how to use ocean observing data collected by buoys, boats and satellites in the Gulf of Maine. The 2004 workshop theme was entitled "Predicting and Detecting Phytoplankton Blooms in the Gulf of Maine." In 2005, the workshop theme was "Seasons in the Sea: Understanding Change in the Gulf of Maine Through Buoys, Boats and Satellites." Our goal for both workshops was to prepare 20 teachers with marine science content and educational tools to use ocean observation data in their curricula. The week-long program designed to achieve this provided background knowledge in ocean science, examples of how to use and create ocean observing classroom materials, structured time to collaborate and brainstorm with other teachers, and authentic access to scientists. Using this approach, we feel that participants walk away with a greater confidence and deeper commitment to integrating ocean science into their existing curricula while also seeing why the oceans are such an important part of understanding our Earth.

Participants discuss how they have previously used marine science data in their classroom/work.

The workshops are open to 20 participants including both formal and informal educators. Most teachers have been from grades 7-12 although some elementary level teachers and principals have attended. The workshop starts on Monday morning at 8:00 AM and runs until Friday afternoon, ending with teacher presentations on the last day.

Each day's schedule is balanced with an equal amount of science content, teacher planning time, practice using tested curriculum, or learning new technology skills useful for teaching. Evening programs are also offered that include guest speakers or additional processing activities. An summary of the 2005 agenda is included here to show the theme and objectives of each day. The full agenda can be found at www.cooa.unh.edu/workshop2005/.

Informal educator Wendy Wicke collects water from a Nisken bottle aboard the research vessel R/V Gulf Challenger.

2005 Ocean Observing Educator Institute

Understanding Change in the Gulf of Maine through Buoys, Boats, and Satellites

Day 1

Theme: Understanding the Gulf of Maine Ecosystem

Objective: Teachers will:

- Learn background information on the region
- Practice using web-based tools to monitor change in the ocean with access to data.

Day 2

Theme: Phytopia and At-Sea Research

Objective: Teachers will:

- Brainstorm what they know and don't know about phytoplankton
- Learn how to use Phytopia CD Rom in order to use it in their classrooms
- Demo lesson plans imbedded within CD
- Participate in a research cruise in the Gulf of Maine on the R/V Gulf Challenger

Day 3

Theme: Research on Three Trophic Levels: Phytoplankton, Zooplankton, and Fish.

Objective: Teachers will:

- Learn about cutting edge research in 3 UNH labs
- Interact with scientists and ask specific questions of scientists in three fields

Day 4

Theme: Detecting Change from Space using Satellites and Curriculum Planning

Objective: Teachers will:

- Learn how satellite images are used both as pictures and as data
- Practice downloading and interacting with different types of satellite images
- Collaborate and brainstorm with other teachers to create practical lesson plans to be used in their classrooms

Day 5

Theme: Final Teacher Presentations: Curriculum Collaborative

Objective: Teachers will:

- Present curriculum materials they have created to the group.
- Explain how they will use what they have generated in the classroom next year
- Gain new ideas from other teachers

Classroom teacher Beth Marass inspects a sample of plankton in a UNH research lab.

C. Key components of a workshop

There are several basic components to consider when leading a professional development workshop for teachers. In order to reach more teachers, we feel it is important to include the following components: 1. Clearly defined and

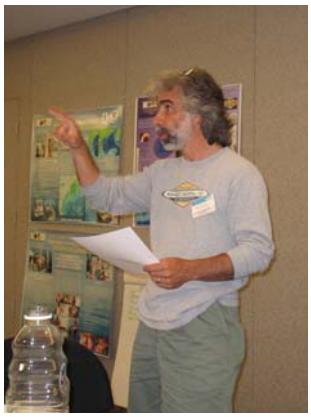
articulated goals and objectives upon which to build a solid workshop framework; 2. Involvement of and communication with scientists and workshop speakers so that they understand the goals of the workshop and what topics to cover if they are not part of the preliminary planning committee; 3. Opportunities for teachers to work with scientists, to learn about their research and the oceanographic equipment they use to help answer key research questions;

Research technicians Rebecca Jones and Erin Gordon explain technology used to study

4. Early advertisement of the workshop to a wide audience using effective means. This year's workshop was distributed to at least 8 different contact databases in order to solicit interest from the New England region and elsewhere. This year's participants were from 7 states: Washington, Pennsylvania, Virginia, Georgia, Massachusetts, New Hampshire and Maine. 5. Specific background materials distributed to participants to read before arriving. This will help create a common foundation or knowledge base within the entire group before beginning; and last but most importantly, 6. An agenda planned with the learner in mind.

Lectures are a fast way of delivering content, but they are not ideal for the learner to absorb, digest and critically think about the information discussed. As a rule, we planned for an equal amount of processing time for all science and educational materials presented. In 2004, "more time for processing" was the most requested feedback from the group. Teachers wanted more time to collaborate and reflect on what they were learning in order to better translate it for themselves and ultimately their students. We believe this to be the most critical piece in planning a successful teacher workshop.

By building in adequate blocks of brainstorming time and requiring teachers to give presentations at the end of the week describing how they plan to integrate this new information into their classrooms, we increase the likelihood that the teachers will feel confident using what they learn in their classrooms.



Middle School teacher Bill Andrake, explains how he plans to use GoMOOS buoy data in his class.

D. What we learned

Both workshops have been called a "tremendous success" based on feedback received from the participants. Although the first workshop ran extremely smoothly, improvements were made in year two that added more substance to

the week. In addition to adding processing time to each day, which teachers felt added a needed depth to their experience, we also increased the time spent in research labs from 15 minutes the first year to 50 minutes in year two. Divided into three groups, teachers rotated through phytoplankton, zooplankton, and tuna research labs where technicians explained current research and gave them a taste of day-to-day studies. News articles and packets of information were also prepared by research technicians as handouts for teachers and their students.

Research technician Chris Manning demonstrates how the zooplankton ring net works.

In order for teachers to get a complete picture of why the research is done, it is important for them to also understand the underlying hypotheses and questions the scientists are asking. Background information for each lab included a list of key questions and current research projects going on in each lab. What is often misunderstood by students and teachers is what is known *versus* what is unknown in a field of science. Students do not understand that many of the basic questions about the oceans have not yet been answered because it is much more difficult to study the ocean compared to the land.

Having teachers learn directly from research scientists gives teachers an authentic experience to share with their students. In turn, scientists also benefit by this interaction as this is a way for them to share their studies and broaden the impact of their outreach.

Teacher Jasmine Charity inspects a lobster before throwing it back.

By running these workshops, we also learned to package and deliver content in more palatable ways. Setting the stage for the week with an introductory oceanography talk is important. This talk must not be rushed; ample time is needed for teachers to ask basic and burning questions they may have about oceanography. This is the time to create an atmosphere of freedom for teachers to ask questions without feeling foolish. Concepts about how marine ecosystems work can be explored and any misconceptions clarified because an atmosphere of trust is established within the group.

During the workshop, participants learned how to use free image analysis software called *ImageJ*. This software allows the user to explore satellite images as pictures of the ocean from space, and also to analyze the data imbedded within the pixels of the image. After learning from year one, the planning committee made changes to the agenda so that remote sensing was

taught last. The background talk and the tutorial used to learn *ImageJ* were improved to greatly increase teachers' ability to understand the material and their excitement about the possibility of successfully teaching this technology to their students.

Informal Educator Karen Romano Young presents her plan for her next children's book.

Each year the planning committee advertises openings for 20 educators to participate in the week-long workshop. This year, we had 3 teachers return from the first year. Unexpectedly, this brought a greater commitment to the group as these individuals had a positive influence on the other participants. These enthusiastic teachers voluntarily shared what they learned from the previous year and how they had been using that information learned in their classrooms. These three teachers have become self-declared ambassadors of the program and will be presenting their classroom materials during next year's workshop.

E. What teachers said

During their final presentations, teachers described numerous ways ocean observing data and information can be integrated into their curricula. Throughout the workshop, teachers were encouraged to give thoughtful consideration to the "enduring understandings" or concepts worth knowing beyond the school-age years [5]. By planning with state and national standards in mind, teachers found ways to teach essential skills using ocean observing case studies. Participants worked together to create detailed outlines of curriculum materials for biology, Earth science, physics, and chemistry at a variety of grade levels. Two elementary teachers and their principals attended the workshop and took away lists of ideas they could use to distribute to their co-teachers and students.

Participants learn remote sensing software called *ImageJ* to study satellite images.

Participants were encouraged to use Bloom's Taxonomy and Howard Gardner's Theory of the Multiple Intelligences when planning their lessons [6]. These two theories provide teachers with a model to help design interdisciplinary units while reaching students with different learning styles and levels. The workshop also modeled different learning styles including an evening of Art in Marine Science. This hands-on activity pushed participants to describe what they have learned about seasonal change in the Gulf of Maine through art.

With a wide range of resources to use, teachers came up with hands-on activities, such as a density lab using

salt, fresh water, food coloring and ice. Others wrote songs about the marine food web as an introductory and/or assessment tool in their unit. Connections to the carbon cycle and the iron fertilization debate were developed, as well as uses of remote sensing technology to understand ocean fronts and their relation to blue fin tuna. A high school chemistry teacher described how learning about tuna tags and the structure of the materials within them would be perfect for students to see how chemistry is an integral part of oceanography.

Through the reports back from teachers, ocean observing data are now being used in their classroom. Teachers explain that the GoMOOS Graphing and Download tool allows them to explore buoy data in a user-friendly format. Teachers are also using the Earth Exploration Toolbook Chapter entitled "When is Dinner Served?" This chapter explains how to download satellite data and buoy data to predict when the next spring phytoplankton bloom in the Gulf of Maine will occur [7].

III. CONCLUSION

In summary, offering 5-day teacher workshops on ocean observing and ocean science is a great way to translate a lot of information to a group of interested individuals about how and why we study the ocean. This forum provides a productive structure for participants to appropriately translate this information to students. The wealth of resources, background materials, and interaction with scientists are essential components to delivering this information. Having authentic first-hand science experiences in research labs and on research vessels combined with the opportunity to create and see other examples of classroom resources are what excite teachers to return to their classrooms to teach their students about the ocean. Because of the amount of data collected by ocean observing scientists, students, teachers, fishermen, coastal managers, stakeholders and others now have a unique opportunity to study and analyze data previously unavailable to the public. Our oceans today are in desperate need of care and protection. Students need to understand how the ocean works, about the animals within it, and how marine ecosystems have changed because of human interaction. Ocean observing data and technology offers a new perspective in how we understand our oceans. In order to reach the next generation of explorers, we need to first reach out to the present generation of teachers.

REFERENCES

[1] American Association for the Advancement of Science, *Benchmarks for Science Literacy Project 2061*, Oxford English Press, 1993.

[2] U.S. Commission On Ocean Policy, 2004. Preliminary Report of the U.S. Commission on Ocean Policy – Governor's Draft.

[3] Pew Oceans Commission, *America's Living Oceans: Charting a Course for Sea Change. A Report to the Nation.* Pew Oceans Commission, Arlington, Virginia, 2003.

[4] G. W. McDiarmid, "*Realizing* new *learning for all students: A framework for the professional development of Kentucky teachers.* East Lansing, MI: National Center for Research on Teacher Learning.

[5] G. Wiggins, J. McTighe, *Understanding by Design*, Prentice Hall, 2000.

[6] I. Forte, S. Schurr, *Integrating Instruction in Science*, Incentive Publications, Inc. Nashville, Tennessee, 1996.

[7] D. Blaha, A. H. Cline, *Earth Exploration Toolbook Chapter: When is Dinner Served*, http://serc.carleton.edu/eet/phytoplankton, 2004.