Ocean Science Education from Museums, Zoos, Aquariums and Science Centers

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I would like to begin by addressing the limits I have put on my remarks: restricting myself to the kinds of institutions listed in the title. The term "informal education" is not well understood by most people. In fact, many of the people who have already or will be speaking today are informal educators. The best way to think of informal education is as free -choice learning: learning in which the individual selects from a very carefully constructed exhibit, program, IMAX, video, book or Internet program what he or she chooses without the intercession of a "teacher". To the uniformed "informal" implies unstructured or disorganized. Nothing could be farther from the truth.

Informal educators implement a large body of research on free -choice learning as well as formal education research. We base our programs and materials on cutting edge ocean science research – often from first person interaction with ocean scientists rather than waiting for primary literature to be published. We test the programs and materials we produce, doing evaluation of learning in the populations we seek to educate. Our evaluations are formative - to insure that we are communicating effectively, and summative – to prove to our funding sources that we have achieved the goals and objectives set forth in our grant proposals. We publish our evaluation results in peer-reviewed literature so that others may learn from our efforts. The quality of our work is evident in our success at competing for funds at the highest levels of science education: the National Science Foundation and Howard Hughes Medical Institute as well as other federal entities, including the National Oceanic and Atmospheric Administration, the National Aeronautical and Space Administration, and the Office of Naval Research.

The informal science education community is also highly engaged in formal science education. A survey in 1996 found that one half of all in-service science education for teachers was provided by informal science educators. Current large formal education programs at the NSF directed at universities and school districts, such as the Centers for Teaching and Learning and the Centers for Ocean Sciences Education Excellence, require one or more informal partners - a recognition of the role informal science education. Howard Hughes Medical Institute acknowledged the value of informal science education in engaging student interest in learning science and pursuing science careers when it created its pre-college informal science program in the early 1990's to address diversity and pipeline issues.

Why include zoos and aquariums, museums and science centers in ocean science education? Each year far more people visit these institutions than attend all professional sporting events. Zoos and aquariums alone see more than 110 million visitors each year. To put a local perspective on these numbers, 10% of the people who live in the

Chesapeake Bay watershed visit the National Aquarium in Baltimore **each** year, and they are not largely repeat visitors. In marketing terms, the National Aquarium in Baltimore (NAIB) has the same market penetrance in the mid-Atlantic region as McDonalds – almost 90% of the population has visited. Most informal science education institutions are mindful of providing access to economically disadvantage visitors by giving steep discounts or free admission during off peak times. In the case of NAIB, Fridays After Five in fall and winter remain $5 – less than 1/3 regular admission - and Dollar Day weekend in early December is our annual Christmas present to Baltimore. Additionally, 65,000 Maryland school children visit free each year with another 140,000 paying out-of-state students.

Museums, zoos, aquariums and science centers have a unique role: they bring **real** things to people who might not have the chance to see those objects, organisms and ecosystems in their natural setting. Several examples of informal institutions setting children on the pathway to science come to mind.

Dr. Stephen Jay Gould, a professor at Harvard University who died several weeks ago, was a respected paleontologist with a great gift for writing about earth and life science in ways that were understandable to the general public without trivializing the science or talking down to the audience. He was raised in New York City, not a place where he could have been expected to see fossils on his own. As a child, he discovered the American Museum of Natural History's fossil collections and became fascinated with what became his life's work.

Dr. Eugenie Clark, zoology professor emeritus of the University of Maryland, was also raised in New York City. Her mother worked Saturdays and had no childcare. Her solution was to leave her daughter at the local informal education institution each Saturday – the New York Aquarium. The young girl fell in love with fish, became knowledgeable about them and started teaching the other visitors each week. From these beginnings came one of the most influential shark biologists of the last century as well as a person who cared very much about both public education and the teaching and mentoring a new generation of scientists.

Both of these important scientists got their start with informal science education. In addition to their research, both accepted leadership roles in conservation and in public education – activities not supported by universities nor rewarded under current tenure systems.

I have seen this influence in my own life. Science was not taught in my elementary school; yet, as a young child, I knew I wanted to be an ecologist. I can identify the informal institutions that shaped my interests: nearby the Bowers Natural History Museum and the Santa Ana Zoo; annual train trips to the San Diego Zoo; occasional visits to the Steinhart Aquarium; and annual high school trips to the Los Angeles Natural History Museum. Girl Scout camping, sailing and canoe trips, and family vacations to western state and national parks provided access to and interpretation of natural

ecosystems. A subscription to the National Geographic magazine showed me ecologist role models.

The question is – how do we use science centers, museums, aquariums and zoos to inspire a new generation of ocean scientists and to education the general public about current ocean sciences research? In understanding how to engage informal science education institutions in ocean science education it is useful to know the ways in which informal science education institutions determine which messages and content they choose, what kinds of ocean science education they currently do, and how their role in ocean science education can be expanded.

Ocean sciences are broad in scope. Some disciplines are well covered and others are poorly represented in informal institutions. Zoos and aquariums are living museums. Their collections determine their messages. Their visitors come to see live animals and ecosystems. Zoos and aquariums do an excellent job of interpreting the biological side of ocean sciences as well as providing important ocean conservation information. Physical ocean sciences are generally presented in the context of impact on living systems. Both natural phenomena such as beach dynamics, hurricanes and El Nino and human impacts such as nutrient loading of coastal waters or global climate change are likely to be addressed. However, you will not learn about ocean currents or Coriolis forces or sea mounts at your average aquarium. Pure physical or earth science does not mesh easily with living collections.

Zoos and aquariums currently do not do a good job of bringing physical and earth ocean science to the general public. These are areas of least understanding and greatest educational opportunity. A number of aquariums joined the federal Coastal America program, a partnership with many federal agencies, that could broaden aquarium messages, but there is no significant funding to support exhibit or program development. Aquariums and zoos have very high exhibit standards that translate into high cost and long timelines. At NAIB we are currently planning the children's hands-on science exhibit that we will be opening in 2007. A good changing exhibit that interprets significant current ocean science and that travels widely among aquariums and zoos as well as science centers and museums would cost $5 million or more. In the absence of outside support, living museums focus on what attracts visitors – the living collection. An additional physical ocean science access point to some aquariums is IMAX. At least 4 aquariums have IMAX theaters built to attract attendance. Their staffs comment on a shortage of aquarium appropriate product.

Natural history museums and science centers are more inclusive in their definition of ocean sciences, giving earth and physical science more exhibit space. They do not do a very good job of providing a comprehensive synthesis of ocean sciences, but they are doing a better job than previously. A recent example of collaboration between university ocean scientists, educators, a museum and a number of federal funding agencies was the cruise that not only studied black smoker deep vents in the Pacific northwest, but also provided engaging daily website stories about the cruise for students and the public and

collected a black smoker which was divided – half to researchers for study and half to the American Museum of Natural History for display.

Partnerships among institutions and significant funding to support both formal and informal ocean science education will have genuine value. Partnerships in the absence of funding have little impact. To be effective, funding needs to be sustained over longer periods of time, providing multiple years of support

Two institutions that comprehensively cover biological, physical and earth systems ocean sciences are the Birch Aquarium at Scripps Institute of Oceanography in La Jolla, CA and the Virginia Marine Science Museum in Virginia Beach, VA. Neither has received the attention it deserves. I would encourage you to drop in on either one to see the marriage of living collections with comprehensive ocean science. Should you wish to see great living collections with some ocean science interpretation – drop in on your local zoo or aquarium next time you are home, check out the National Aquarium in the Department of Commerce basement that deserves more recognition, or head up the road a bit to Baltimore. We are all delighted to have you visit.