

The role of museums in geoscience education: A perspective

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Publicly accessible museums are cultural centers that enrich the life of a community. From an educational viewpoint, they provide informal, lifelong learning experiences. In Lee and Fortner's 2005 survey of geoscience educators, informal science education ranked as an important instructional approach for the future of earth science education.

So how do museums in particular educate? Meeting the educational needs of an audience that ranges in age from about 6 to 90 years with diverse backgrounds, interests, and life experiences is challenging. Studies exist that attempt to clarify how learning occurs in museums and which best practices enhance the learning environment; however, the field continues to evolve. What follows is a survey of what is generally considered common knowledge among museum professionals (e.g., Bloom and Mintz, 1990) along with examples from personal experience.

Objects and exhibitions. The most visible and expected offerings of a museum are its exhibitions. Exhibitions tell stories through objects (Figure 1). In a world where virtual experiences are ever increasing, museums provide tangible encounters with real objects.

What does looking at a crystal clear specimen of beryl, a vertebrate fossil emerging from its plaster jacket, or the flag that flew over Inge Lehman's seismological observatory provide in an educational sense? Some professionals maintain that the visceral reaction of wonder, awe or curiosity—the affective response of the viewer—is the enduring legacy of a museum visit. It opens the door to the visitor's mind, engaging them in a discipline that perhaps failed to interest them through other means, and might inspire them to learn more. Furthermore, the social context of a museum visit, where exploration occurs in a friendly atmosphere without the pressure of tests and grades, helps keep that door open.

Curators and educators also aspire to engage the rational mind of the viewer. A mineral collected in the field and displayed in the museum is out of its original context, but thoughtful juxtaposition of the mineral with other objects helps the visitor make new connections. Exhibit labels or a knowledgeable docent leading a tour not only inform directly, but also guide visitors in making their own observations of the object. Hands-on displays combined with objects can provide forceful connections—an “aha!” experience for the visitor. Alan J. Friedman, the former director of the New York Hall of Science, recounts a watershed experience during a 1970 museum visit in which a model telescope that he could touch and adjust brought to life the meaning of the antique telescope sitting behind glass (Friedman, 2007).

Integration. A current trend in education is the use of integrative or multidisciplinary approaches in learning. Museums, especially general museums, are well suited to use this approach and thereby complement many aspects of the formal curriculum. On the surface, the Bruce Museum exhibition on the domestic dog would not be considered part of the discipline of geology (Figure 2). However, incorporating fossil relatives of the dog added depth to the consideration of dog evolution, just as ethnological artifacts



Figure 1. This 17 cm tall, clear beryl crystal from Brazil grabs the museum visitor's attention. (Bruce Museum collection, Gift of Mr. and Mrs. Robert P. Ewing 86.35. Photo: Denis Finnin.)



Figure 2. “The Nature of Dogs” was a Bruce Museum exhibition that incorporated objects and concepts from multiple disciplines including paleontology, genetics, behavioral biology, and archaeology.

and a complementary exhibition on dogs portrayed in art provided human cultural perspectives.

The Museum Experience. Museums are typically concerned with the nature of the experience they provide their audience. Participation from their visitors enhances learning and gives museum patrons a positive sense of time well spent. While museums, like professors, are commonly perceived as subject-matter experts, both educate more effectively by combining traditional didactic methods with personal discovery. As Stapp (1984) states, “The museum ... should undertake to offer the public something of the caliber of experience enjoyed by the expert.”

Promoting increased intellectual participation can be as simple as asking a provocative question on an interpretive label or juxtaposing two seemingly disparate objects to startle the viewer into forming their own question. Science centers, which are less concerned with objects and more focused on conveying scientific principles, processes, and phenomena, are skilled at developing interactive displays that use physical or “hands-on” participation to encourage engagement.

At the Bruce Museum, we have had success with some very simple interactive components. A meteorite hunting board game where players tried to find as many meteorites as possible was popular with family groups. It encouraged learning in a social and enjoyable context while conveying some of the real challenges professionals encounter. For example, one game card instructed, "You are lost in a snow squall in Antarctica. When the sky clears, you find you have discovered a new meteorite field. Collect 3 meteorites."

In several exhibitions, we have used a set of four transparent tubes as a mechanism for capturing the visitors' point of view or their understanding of a topic (Figure 3). A question is posed, usually one that does not necessarily have a definitive answer or was a source for scientific investigation such as, "What caused the extinction of the dinosaurs?" Each tube is labeled with a possible response. The visitors are asked to commit to a choice by putting a coin in one or more of the tubes. Making a choice is a thoughtful activity, and not having "the answer" helps the visitor understand that scientific knowledge is not a set of facts delivered by an authority, but rather is constructed through a process.

As a complement to their exhibitions, museums also provide public programs that promote participation in learning activities. Lectures and film presentations followed by discussion sessions are popular with the adult learners in the Bruce Museum community. For example, they relished the opportunity to ask Peter Rona directly about his experiences investigating hydrothermal vents and then continued their discussions in small groups over wine and cheese. Special events such as "Rock and Mineral Family Day" at the Bruce provide opportunities to dig for minerals, polish amber or learn how to use a map and compass. Most public programs occur on the museum campus, but many museums also offer educational excursions. While a cave exhibition was on display at the Bruce Museum, a group of about 26 adventurers, ranging in age from 10 to 80 years, explored a marble cave in western Connecticut (Figure 4).

Misconceptions. Educators in all settings face the challenge of participants with preconceived, erroneous notions about some aspect of science. In Rebich and Gautier's 2005 study, they discovered that some college students thought global warming resulted from increased insolation through the ozone hole and that greenhouse gases are pollutants. Misunderstandings like these are particularly resistant to change, but the study also indicates that collaborative learning and problem-solving activities are helpful in replacing them with correct conceptions.

This suggests that the social context of the museum and its interactive components can be useful in facing this challenge. However, as Borun (1989) points out, this requires that museums perform front-end evaluations of their exhibitions in order to identify the misunderstandings that need to be addressed, as well as summative evaluations to assess the exhibition's effectiveness.

Partnerships. Museums further their educational goals through collaboration with both formal and informal institutions. Partnerships with the local K-12 community are imperative for museums to retain their viability. State and national science standards usually are broad enough that museums can find links to their mission and the topics presented in exhibitions. Museums thus enrich student learning, going beyond the proscribed curriculum to provide specialized content expertise.

At the Bruce Museum, we offer school tours, school outreach programs, after-school programs, and teacher devel-

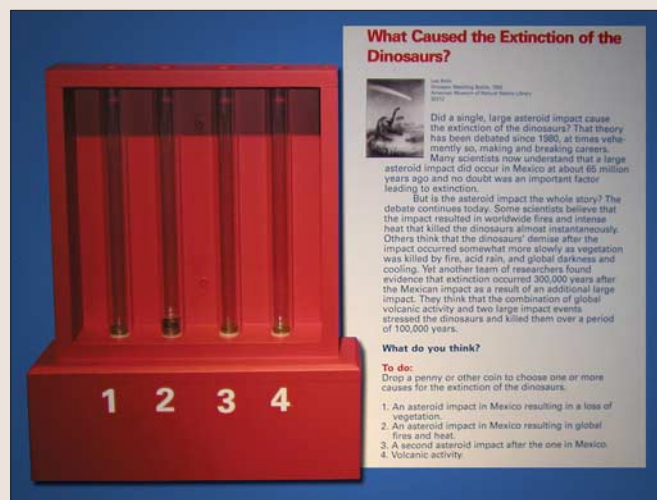


Figure 3. Visitors participate in their museum experience through interactive displays. Here the tubes represent responses to a question, and visitors commit themselves by adding a coin to one of the tubes.



Figure 4. Two youngsters work their way through a tight squeeze in a Connecticut cave on a museum field trip.

opment based on our permanent and temporary exhibitions. Our "Mineral Marvels" program is a popular request of teachers, second only to a program on Native Americans. "Phenomenal Weather," an exhibition planned for March 2008, resulted in part from a request by the science coordinator for the Greenwich, Connecticut public schools.

Engaging high school and college students via exhibition programs is more challenging, and many museums obtain better results by involving the students in museum work. The American Museum of Natural History has a program that matches high school students with curators who guide them in a research project. Curators there also serve as graduate advisors to university students. The Bruce Museum trains high school students as junior educators who lead after-school programs at the museum, and we also offer opportunities for college interns to learn about natural history curation. A paleontology professor at Clemson University, in collaboration with the university's Bob Campbell Geology Museum, set the students' field and laboratory activities within the context of developing an exhibition. The result was a mutually beneficial venture. His students learned about communicating their discipline to



Figure 5. A museum visitor touches the global seismicity display to see the magnitude, date, and location of a particular earthquake. The live-feed Web site was developed and modified for the museum by IRIS.

the public, and the museum obtained a new display.

While collaborations between museums and the formal educational establishment are a priority, connections to other informal organizations also benefit their communities. Opportunities exist for museums to work with local institutions, such as continuing education programs, and mineral and fossil clubs, or with organizations associated with the larger scientific and educational communities. For example, the Bruce Museum enjoyed partnering with Incorporated Research Institutions for Seismology (IRIS) on

what turned out to be a very popular display featuring a live feed to information about global seismic events (Figure 5). IRIS also provided supporting educational materials for our teacher workshop. In return, the museum provided suggestions for visitor-friendly design changes and supported the IRIS 2006 grant proposal. We currently are looking forward to being part of the 2008 International Year of Planet Earth activities as described by deMulder et al. in this issue, with exhibitions on weather and climate change.

Natural history and science museums are important resources in the overall context of geoscience education. Through their objects, exhibitions and programs, they communicate the import of earth science to the man-on-the-street and further the scientific endeavor. **TJE**

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Suggested reading. "Museums and the future of education" by J. N. Bloom and A. Mintz (*Journal of Museum Education*, 1990). "Naive notions and the design of science museum exhibits" by M. Borun (*Journal of Museum Education*, 1989). "The extraordinary growth of the science-technology museum" by A. J. Friedman (*Curator*, 2007). "International geoscience educators' perceptions of approaches to K-12 science education for the 21st century" by H. Lee and R. W. Fortner (*Journal of Geoscience Education*, 2005). "Defining museum literacy" by C. B. Stapp (*Roundtable Reports*, 1984).

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