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Feature
Educator Highlight

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Note from the Editor

Educator Highlights for *CBE—Life Sciences Education* show how professors at different kinds of institutions educate students in life sciences with inspiration and panache. If you have a particularly creative teaching portfolio yourself, or if you wish to nominate an inspiring colleague to be profiled, please e-mail Laura Hoopes at lhoopes@pomona.edu.

LH: Maritza, what kinds of educational activities happen at your museum?
MM: In addition to the scientific and exhibition departments that provide the research and interpretation of science and culture for the public in general, we have three distinct centers in the education department. The Centre for Lifelong Learning offers all public programs designed for multiple audiences who see the museum as a scientific and cultural place of enjoyment and learning. These include programs for families with children and adult audiences. The Gottesman Center for Science Teaching and Learning provides programs and resources to formal education from pre-K to 16th, field trips for half a million students a year, and professional development programs for teachers in all areas of science in the forms of workshops, summer and winter institutes, and graduate programs for science teacher education institutions. The Center for Science Literacy, Education and Technology develops all digital and online educational resources and courses. For example, our Seminars on Science provide science and pedagogy graduate online courses designed and taught by teams of teacher educators (pedagogy) and scientists (content). We also have extensive online resources and programs developed around specific exhibits (see www.amnh.org/education).

LH: Do you work on both exhibits and activities?
MM: Yes, I do a lot of work planning and running graduate-level courses for teacher education programs in the sciences. I also work with interdisciplinary teams in the planning and evaluation of exhibitions.

LH: Can you give me a detailed description of one such activity?
MM: We recently conceptualized and proposed a traveling exhibition on systematics. I was part of the design team with members from the exhibition and the curatorial staffs. I brought in the educational goals, relevant research on learning in museums, and the specific science content required for teachers and students. This particular exhibition is on taxonomy and the importance of discovering new species: the process of investigation, research, analysis, and the resulting contribution to the Tree of Life.

Maritza Macdonald, Senior Director of Education and Policy, American Museum of Natural History, New York, NY

Working with student populations new to the American geography, climate, and seasons, I end up teaching a lot about ecosystems. Everyone comes from somewhere and knows their own ecosystem. They can use that prior knowledge to learn about other ecosystems. In teaching, I make sure that the learners focus on real objects and specimens in the exhibitions to use that evidence and develop concepts based on real objects. They need to hold things in their hands, feel the texture and size, and engage in description and questioning. We don't intend to be a 'don't touch' museum, and with technology and new labs for the public,

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access is getting better. Natural history museums depend on collections, and in our case the work of more than 200 research scientists who inform the exhibits and the programs.

We also emphasize using evidence on science learning and response to the accountability structures for teacher professional development and for student scientific achievement. In professional development, for example, we are very mindful of two types of research. Research on Learning Science in Informal Institutions (Bell *et al.*, 2009), which is readily available through the Center for the Advancement of Informal Science Education, because we are a museum with specimens, exhibitions, and programs for teachers, students, and the public. Second, we respond to national documents like the AAAS *Atlas of Science Literacy* from Project 2061 (American Association for the Advancement of Science and the National Science Teachers Association, 2007), because our Gottesman Center is charged with supporting all formal science program requirements.

LH: I loved your dioramas as a kid. Do you still have those?
MM: Yes, the dioramas are famous and timeless. In a recent book called *Windows on Nature*, the author, Steven Quinn, revealed their history and influence over the past 100 years. Teachers and children use the dioramas to observe what is happening in a given setting and use that for evidence about that ecosystem, always knowing that the "real world" gives us evidence and information. They are also fascinated by being able to be so close and yet protected from the large brown bear or bison. You can talk about the ecosystem without having animals disappear and reappear as you speak. At the dioramas of past eras, based on real bones and gigantic teeth, you can talk about the dinosaurs and the ecosystem they inhabited, which is very difficult to do just looking at our present world.

LH: What has been the most exciting highlight of your work at the American Museum of Natural History?
MM: Developing graduate-level courses for new science teachers using the incredible resources from the museum: collections, exhibitions, online resources, digital visualizations, and our scientists. It makes me and the teachers excited about the profession and about the resources available outside of schools.

LH: Do you mainly work with local teachers?
MM: Our work is not just local; the online courses have groups studying systematics from California, and astronomy from South Africa. (www.amnh.org/learn).

I want to use all sorts of media to let people see how scientific activities such as collecting and comparing samples provide strong evidence. We have developed science bulletin videos that show scientists at work to provide observers with real evidence of how science happens, and the exciting (or not so exciting) contexts for science research, along with illustrating the many types of scientists there are (www.amnh.org/sciencebulletins).

LH: How do you decide what the goals of such an activity will be?
MM: We think it all through in advance. Let's say we make an exhibit on butterflies. It's not just about how beautiful they are. We try to demystify the taxon, the class they belong to, their bio-geological locations, and their roles in the natural world. At the same time, we're trying to address the big themes, like health, climate change, or water conservation. Or we will center an exhibit on the advances of science and technology through the ages, as in exhibitions like the Silk Road, which just opened at the museum. No two semesters are alike. Each temporary exhibit takes us into incredible intellectual field trips.

LH: How do you evaluate whether the visitors are learning what you want them to get out of it?
MM: I lead the evaluation team; we have multiple ways of evaluating our programs and exhibitions. First, we do in-house, front-end evaluations to assess interest and need by audiences that usually use this museum. Second, we do formative evaluations of new concepts that we have not used in prior exhibits and programs. Finally, we do extensive summative evaluations of programs and exhibitions. We hire external evaluators with different expertise as needed, and in cooperation with the evaluators, we develop the research questions that will help improve exhibits in order that the educational content is more easily accessed by all kinds of visitors. Right now, we are focusing a lot on family and group learning, which is really a great dynamic to observe and study on weekends.

We actually look primarily for attitude changes. The National Science Foundation (NSF) IMPACT assessment emphasizes awareness, engagement, and behavior of the students as they develop skills using our materials. We also expect that family learning will be rich and well informed as a result of a successful exhibit or activity, since families educate, and are often charged with explaining the natural world to, their children. We want all visitors to think like scientists. Discoveries happen around the world, in urban parks, not just in rain forests. Science is a human endeavor: it's unraveling mysteries. If the exhibits are right, the kids can't resist exploring the ideas.

LH: Do you see scientific thought as linear, as it was once presented to me many years ago?
MM: That notion is not used much anymore. Science is never finished, and that is a difficult perspective. We all want definite answers and definite solutions. Technology allows us more room for exploration and discovery, both in making observations and comparing our observations to those of other people. You see a butterfly. You see something else that looks like a butterfly, but it isn't. It's a moth. Why is it not considered a butterfly? How are they different? You then follow a definite protocol to seek clues and get an answer. Like the butterfly finding the best flower, we too engage in a not-so-linear search. Technology and tools are fun if they aren't presented in intimidating ways, and kids will use them to explore questions they find interesting.

LH: How were you trained? Did you plan to have the position you now hold?
MM: I am and have always been a teacher. I am also bilingual and extremely committed to equity. I taught in classrooms in urban settings and in migrant communities in California. I taught teachers in New York City, received a Master's degree from the Bank Street College of Education and a Doctorate from Columbia Teachers College. I believe that one can teach anywhere. Whether it was a college, university, migrant camp, or a classroom in Manhattan, I felt that the quality of my work was better when I could share,

give away, and use appropriate resources. I wanted to have an influential position where I could both do direct teaching and affect the policies of the institutions, and the museum has given me that opportunity.

LH: Can undergraduate students work at your museum? If so, what kinds of things can they do?
MM: Yes; we have multiple internships in the summers and in the academic year. We receive funding from the NSF for Research Experiences for Undergraduates. Undergraduates work with our scientists, or they also can apply for internships in the Education Department and work with the summer education programs. We also have an accredited doctoral program in comparative biology through our Richard Gilder Graduate School. For example, we have a Center for Comparative Genomics that utilizes a collection of frozen tissues where genetic comparisons can be done, exploited by herpetologists, ichthyologists, and many more specialties. In addition to the biological sciences, we have departments of Earth and Planetary Science, and Astrophysics.

LH: What vistas do you see for museums in science education of the future?
MM: Museums need to be considered very seriously as content providers, enabling people in general to get a deeper knowledge of how science is so much a part of our lives. Museums can also add value to learning experiences in formal contexts, like schools and universities. Learning in museums engages more than the linguistic and mathematical ways of learning. In a museum, we are bombarded visually and aesthetically. We see things in context, and find our humanity as we move from science to culture in our anthropology halls, where we see the connections of science and technology affecting societies all over the world from ancient times to the present. In all exhibit halls we see three-dimensional representations that visually engage us, for example, with the wonders of the universe or the deep oceans. Every student, not just in science, needs experiences with the real dimensions of nature, and the tools of investigation.

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