

Taking Students to the Museum: Interview with Warren D. Allmon, Judy Diamond, and Martin Weiss

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Abstract Three museum professionals with extensive expertise in informal science education about evolution—Warren D. Allmon, Judy Diamond, and Martin Weiss—are interviewed about the interaction of teachers and natural history museums and science centers in improving the effectiveness of evolution education.

Keywords Evolution · Museum · Informal science education · Warren D. Allmon · Judy Diamond · Martin Weiss

How can natural history museums and science centers help teachers to educate their students about evolution? How can teachers prepare themselves, and prepare their students, to take full advantage of the opportunities to learn about evolution afforded by natural history museums and science centers? And what can teachers do to help their colleagues in informal science education in their shared responsibility to overcome the obstacles to evolution education? Those were the questions that came to mind when we learned about the theme of the present issue of *Evolution: Education and Outreach*, and those were the questions that we posed (separately) to three museum professionals with extensive experience in conveying evolution in informal science education.

Warren D. Allmon is the Director of the Paleontological Research Institution, which operates the Museum of the Earth in Ithaca, New York, and the Hunter R. Rawlings III Professor of Paleontology at Cornell University. Judy

Diamond is a Professor and Curator of Informal Science Education at the University of Nebraska State Museum; she was the principal investigator for the National Science Foundation-funded Explore Evolution project, which includes permanent exhibit galleries on evolution at four museums around the country. Martin Weiss is a Senior Scientist at the New York Hall of Science; he curated and researched the touring exhibition Charlie and Kiwi's Evolutionary Adventure, on the link between dinosaurs and modern birds.

1. Why take students to a natural history museum to learn about evolution? What's the educational advantage? Why not just stay in school with the textbook?

Diamond Natural history museums aren't the only places to learn about evolution, but they have specimens that show evidence for evolutionary changes. Many have excellent evolution exhibits that provide teachers and students with opportunities for learning through direct experience with ideas, evidence, and evolution research.

Allmon It's all about having some sense that these are real objects, from real creatures. Increasingly, kids aren't seeing real stuff; they're seeing only virtual stuff, washing over them in virtual reality. One of the most common questions we get from kids is "is that real?" We used to say that casts were copies; now we say that casts are *exact* copies. We've learned that if they find out that a cast of a *Tyrannosaurus rex* tooth isn't real, half of them will walk away, but fewer will do so if it's described as an "exact copy." And again, it's about the sense of reality. You can get expertise and content from books and websites, but to get the sense that these are authentic objects that tell you something about the real world, you need real stuff. Particularly for younger kids,

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touchability and some kind of docent-mediated experience are helpful. (Many museums will not let you touch a lot of actual specimens, and that's a problem.)

Weiss Research has shown that students understand change best from fossil evidence, and where better to see fossils and the scientific evidence for evolution than at a natural history museum? There are many good examples in museums showing the changes that occurred over the millions and millions of years of evolution, and it is much easier to see them and perhaps touch them in a museum than in books. In addition, many museums have specialists, not only paleontologists, but also educators who would guide students in classes through the galleries or in workshops. These educators are specially trained to introduce evolution through the use of the fossil evidence in their collections.

A further consideration is that teachers can use the museums as “cover” for introducing evolution to their classes, especially when there can be student and parental pressure against teaching it. Museums have authority on science, so teachers can use them to support their authority as teachers.

2. How should teachers prepare themselves to take full advantage of the opportunity? Should the teacher consult with the museum staff beforehand?

Allmon It depends on the grade level. A high school teacher is probably looking to fill very specific learning goals, keyed perhaps to state standards, and so a pre-visit by the teacher would be best.

At younger ages, the specifics are less important and the approach is more important. It's what I call the “one hour with a paleontologist” problem: if I have one hour with you, and you'll probably never meet another paleontologist in the rest of your life, what should I convey to you? I could spend a whole hour talking about a particular technical point of paleontological detail, or I could encourage you to explore how fossils are used to think about change over time: I could teach you to fish instead of giving you fish.

And that's what we try to do. For example, here in Ithaca, fossils from the Devonian are abundant; just about every kid here has picked up a fossil. And just about every kid knows what a coral is (even if they don't know that it's an animal and not a plant). So with six-year-olds, we show them a modern coral and then show them a fossil coral, saying, “I found this fossil coral on the shore of Cayuga Lake”—and then we just shut up, we don't say anything else. And it has been one of the great joys of my career to watch what happens. All of a sudden, they say: the ocean used to be here! They didn't hear it from me, they didn't read it in a book, and they didn't hear it from a teacher: they figured it out for themselves. That's far more important than filling them full of specific details.

Weiss Definitely consult with the museum educators. The time consulting with them before the visit will enhance the visit immeasurably through the guided tours and materials that they have developed for study before the visit.

I would also suggest perusing the offerings of the Understanding Evolution website from the University of California Museum of Paleontology (<http://evolution.berkeley.edu>) for information appropriate to the age of their students. This is an authoritative source of information for elementary school children through 12th grade. I would especially suggest a focus on how evolution occurs, the theory of natural selection, which often is not presented in an age-appropriate manner in many museums.

Diamond It is always useful to consult with a museum representative before visiting to become informed about special programs and other opportunities. Many museums offer inquiry-based programs that enhance the experience of visiting an evolution gallery. The University of Nebraska State Museum offers various levels of inquiry-based programs on evolution for students from elementary to graduate school.

3. How should teachers prepare their students to take full advantage of the opportunity? What should they study before or after the trip?

Weiss Having some understanding of how evolution occurs through natural selection would allow the students to get much more out of the visit. And discussion after the trip can help to explore how the visit enhanced their understanding of how evolution occurred—and is occurring. One aspect of evolution that is not often emphasized is the fact that evolution has not stopped. Researching how scientists are understanding ongoing evolution, and the scientific evidence for it, can be extremely rewarding, especially when it concerns us. There are numerous examples of how we understand evolution through study of our bodies and our health.

Diamond The best preparation for a visit to a museum evolution gallery is to spend class time discussing the principles of evolution and relating these to other aspects of students' lives, such as health, food, and the environment. More information about the Explore Evolution exhibits is available at <http://explore-evolution.unl.edu>. (Don't confuse our National Science Foundation-supported Explore Evolution galleries with the creationist textbook with the same name!) The Understanding Evolution website from the University of California Museum of Paleontology at <http://evolution.berkeley.edu> provides many useful activities for teachers and students to prepare for an evolution gallery visit.

Allmon In our experience, it depends on the teacher. We haven't been very successful in dictating exactly how to prepare for the museum visit. We do provide one or two grade-specific pages saying, "In the museum, you will see ..." but beyond that there's a lot of practicality to what is appropriate: if the students only have an hour to visit the museum, then it makes sense to specify the learning goals. But we've found that in general, it's better to put the emphasis on letting the teacher decide how to communicate and what to emphasize with the students.

4. Do you have any specific examples to share of materials at your museum that are especially relevant to teaching evolution?

Weiss Evolution is counterintuitive, and special care is needed to understand it and to teach it to different ages. So we developed Charlie and Kiwi's Evolutionary Adventure (Fig. 1), an exhibition focusing on dinosaur-to-bird evolution (<http://www.nysci.org/explore/ontour/charlieandkiwi>), because the age group we focused on (seven to ten) is especially interested in dinosaurs and birds. This was geared to children but I am certain that adults, including teachers, learned a good deal from it.

Allmon We emphasize authenticity and touchability—we're a small museum with about 40,000 visitors per year, so we can have a lot more touchable stuff than the Smithsonian can—and the ways in which we investigate questions in paleontology.

We have a separately funded program through which every single first grader in Ithaca comes to the museum. The class gets a pre-visit from a museum educator, a visit focused on dinosaurs, and a post-visit from a museum educator. First graders are crazy about dinosaurs, of course!



Fig. 1 Students explore "Charlie and Kiwi's Evolutionary Adventure" at the New York Hall of Science. Photograph by David Handschuh, courtesy of the New York Hall of Science

The museum visit features touching real things like dinosaur poop and dinosaur bones—that's what they remember. But they're also learning the basics: what fossils are and that different fossils occur in different layers of rock.

New York has only one site with dinosaur fossils, an outcropping behind a car dealership in the Hudson Valley. The fossils are miserable, ugly-looking dinosaur footprints from the late Triassic. A permanent exhibit at the museum (Fig. 2) displays one of these footprints along with a cast of a dinosaur similar to those that might have made it (*Coelophysis*, from New Mexico) and asks, How do you go from a footprint to a dinosaur? And we do a presentation on how paleontologists can learn about the dinosaur just on the basis of its footprint. Similarly, the number one question kids ask us is, "How do you know what color they were?" We say that have no idea. And this starts a conversation about how and why artists choose the colors they do for dinosaur reconstructions. This then becomes a discussion about how paleontologists reconstruct the past.

Diamond The NSF-funded Explore Evolution exhibits (Fig. 3) are permanent galleries in the university museums at the University of Nebraska at Lincoln, the University of

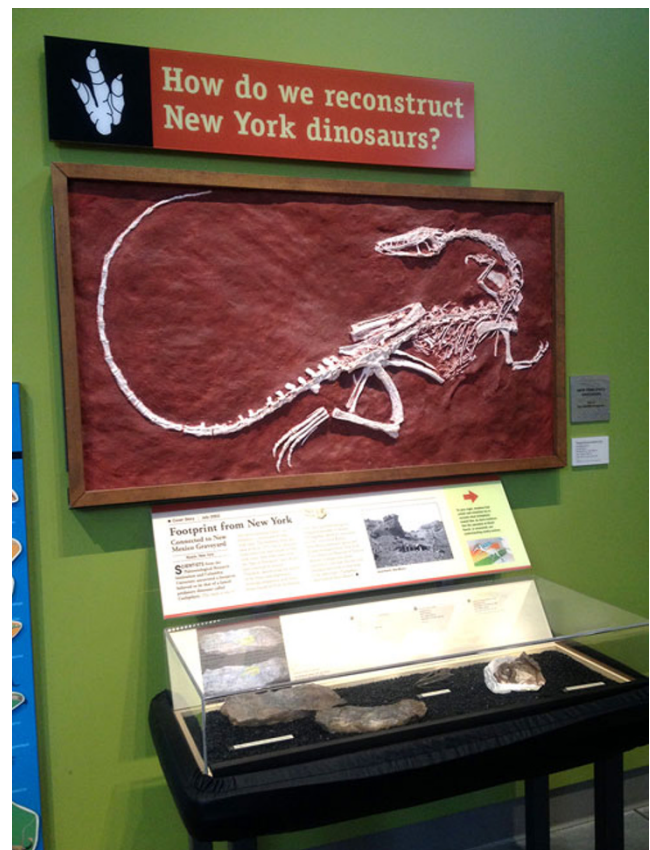


Fig. 2 "How do we reconstruct New York dinosaurs?" display at the Museum of the Earth. Courtesy of the Museum of the Earth



Fig. 3 Banner advertising the Explore Evolution exhibit at the Carnegie Museum of Science. Courtesy of Judy Diamond

Kansas at Lawrence, the University of Michigan at Ann Arbor, and the University of Texas at Austin. A fifth exhibit currently travels around the United States. Teachers use the exhibits in innovative and substantial ways. Several religious groups in Nebraska regularly bring high school students to visit the Explore Evolution gallery. These students are given the opportunity to be introduced to evolution in a context where they can obtain accurate and accessible information about basic principles and current research on evolution. Some teachers bring their students to the Explore Evolution gallery because they do not have the institutional support to present evolution in their classrooms. For these teachers, the museum is perceived to have more substantial community support for teaching evolution than does their own school.

5. What extra steps is your museum taking to promote effective evolution education among teachers (i.e., beyond exhibits: workshops, lectures, websites, etc.)?

Diamond The Explore Evolution team created an activity book with Carl Zimmer and Margaret Evans so teachers and students could experience the gallery regardless of whether or not they could visit the museums. The book, *Virus and the Whale: Exploring Evolution in Creatures Small and Large*, is available from the National Science Teachers Association Press (<http://www.nsta.org/recommends/ViewProduct.aspx?ProductID=16142>). Also, the evolutionary biologist and writer Richard Dawkins visited the Explore Evolution gallery in Nebraska several years ago and made videos of himself explaining the exhibits. These “Nebraska Vignettes” are available on his website at http://richarddawkins.net/rdf_productions/vignettes.

Weiss We’re particularly proud of the companion volume to our Charlie and Kiwi’s Evolutionary Adventure exhibit: *Charlie and Kiwi: An Evolutionary Adventure* (New York: Atheneum Books for Young Readers, 2011), written by Eileen Campbell and illustrated by Peter H. Reynolds. It brings the exhibit to a bookshelf near you! *Publishers Weekly* said, “the story’s fast-paced narrative and cartoon vignettes do a commendable job of explaining how small adaptations over time lead to evolution.”

Allmon We do a lot, at a lot of different levels. The Cadillac of what we do is a National Science Foundation-funded project called Fossil Finders (<http://www.museumoftheearth.org/outreach.php?page=overview/evolution/777644>), which is designed to get teachers more comfortable with using actual fossils from their local area in teaching earth science and evolution. It’s very intensive: we have weeklong trainings with teachers in the summers as well as enrichment activities and follow-up with museum staff conducted online. We’re now trying to scale up the project with partners around the country.

Fossil Finders, like a lot of our programs, takes the general approach of empowering science educators to go out in their own local areas (their “backyards”) and use whatever’s available to teach with: fossils in your backyard, climate in your backyard, and evolution in your backyard. The essential idea is that you can go outside and take two or three objects and derive, say, descent with modification from those objects. The idea goes back to Thomas Henry Huxley’s essay “On a piece of chalk” (1868). It works if you walk the teachers through it and emphasize basic principles of historical science: you’ve got to get them comfortable with “flying without a net,” because many are not used to teaching this way. But once you get them empowered, they can teach themselves after that—but man, is that hard for an average teacher!

6. What can teachers do to support effective evolution education in their local natural history museums?

Allmon First of all, use them! Teachers should feel that natural history museums are essential. Whether it’s a small or a large museum, teachers should say to principals and parent–teacher associations that going to the museum is not a frill, not something that classes only do in June when we’re out of other things to do, but a crucial part of science education. (If teachers don’t feel that way, then museums aren’t doing their job!) I was recently visiting my child’s school and a teacher praised the Museum of the Earth as an essential resource, not knowing that’s where I work. That really made my day.

Teachers can also be really effective ambassadors for the museums to the community. Not every community has a natural history museum, but lots of them do, often at a local university or college. Teachers can play a big role in telling people how great the museum is—and if it's not so great, they can play a big role in telling the museum *that*. This is very useful especially for university museums, which are often small and struggling; since administrations are always trying to close them or squeeze them, it can be really helpful for teachers to tell the universities how useful they are.

Diamond Finding time to teach evolution in science classrooms is the best way that teachers can support evolution education in their natural history museums. Teachers and

natural history museum staff can work together to integrate their resources, to ensure that the museum visit builds on teachers' curriculum goals, and to make sure that the best possible efforts are made to support evolution education. Natural history museums can play a role to strengthen community support for teaching evolution in the schools, in after-school programs, and through life-long learning.

Weiss If teachers would make their needs known to the educators at their local museum, I think there could be greater help coming from the museum. Unfortunately, it takes money and time to develop programs—both hard commodities to come by in these times.