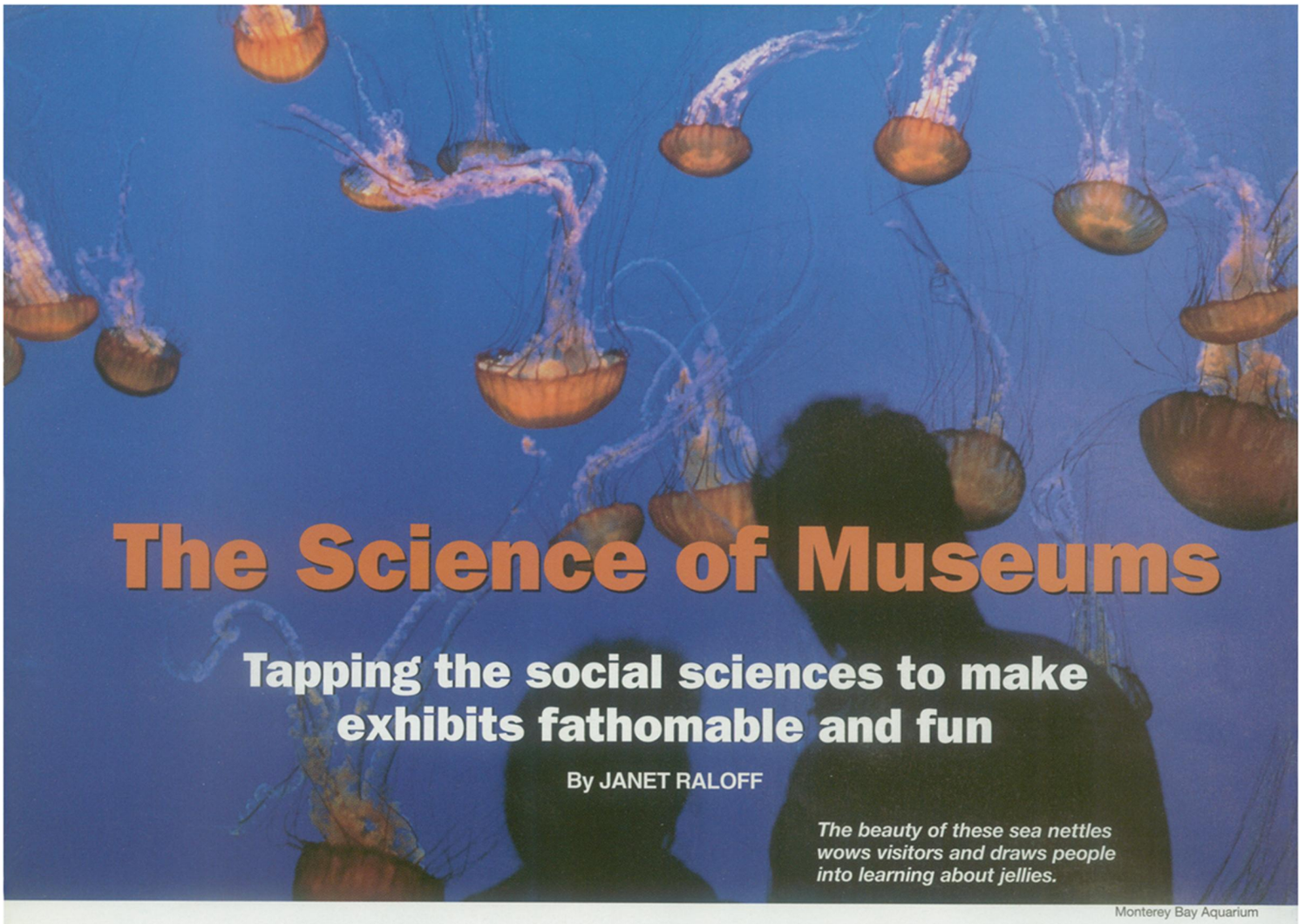


The Science of Museums

Tapping the social sciences to make exhibits fathomable and fun

By JANET RALOFF

The beauty of these sea nettles wows visitors and draws people into learning about jellies.

Monterey Bay Aquarium

Smithsonian Institution

When the Smithsonian Institution's National Museum of Natural History decided to update its 30-year-old Hall of Geology, Gems, and Minerals a decade ago, the curators accepted that its centerpiece would remain its famous necklace—the one sporting the 45.5-carat Hope diamond (left). The most viewed museum object in the world, it draws more than 5 million visitors annually.

The challenge to staff scientists lay in attracting visitors to the hall's many other exhibits, recalls Lynn D. Dierking of the Institute for Learning Innovation (ILI) in Annapolis, Md. The museum hired her firm to evaluate key facets of the renovation project.

Fortunately, Dierking notes, the curators' task turned out to be far less daunting than they had anticipated. Only 10 percent of the hall's visitors come solely to view the Hope diamond, ILI's surveys revealed. Moreover, 40 percent made Geology, Gems, and Minerals their first stop at the museum even though this exhibition is on the second floor, requiring a walk past the entry level's renowned dinosaur exhibit. She concludes, "We've got destination shoppers"—visitors clearly drawn to crystals, meteorites, and volcanoes.

Collectively, U.S. science and technology centers bring in more than 130 million visitors each year. And increasingly, their most successful exhibits owe as much to evaluation of visitor reactions as they do to ample budgets and careful planning, says Jeff Hayward, a 21-year veteran evaluator who directs People, Places & Design Research in Northampton, Mass.

Fifteen to 20 years ago, virtually no museums considered evaluations to be part of their exhibit-development process, says ILI director John H. Falk. Indeed, exhibit appraisals "were more curiosities than management tools until about 10 years ago," Hayward maintains.

Even today, though the need for evaluation is well accepted in the science-museum community, "there are still probably only a handful of institutions in the country that are religious about it, in the sense that they do it for all of their exhibitions and programs," Falk maintains.

One of the most conscientious institutions is the Adler Planetarium and Astronomical Museum in Chicago. Patty McNamara of Adler argues that creating a project without evaluation amounts to gambling with what are often huge budgets and also with the opportunity to communicate the intended message.

The most common type of visitor-evaluation study takes place early during the production of an exhibit. Typically, the designers craft a rough mock-up and put it on the museum floor for a few days or weeks. Trained observers then analyze how people interact with it.

This process can identify obstacles that might prevent a visitor from experiencing what the museum intends. Potential roadblocks can be as mundane as a knob that's hard to reach, instructions that are too complicated, or an interactive display that takes too long to respond. Yet, even an exhibit that operates flawlessly can possess subtle features that undermine its message, notes Sue Allen, one of two full-time evaluators at the Exploratorium in San Francisco. To find these problems, evaluators must talk to visitors and be alert for cues that the viewers are drawing inappropriate conclusions about what they see, hear, or feel.

Allen encountered one such conceptual booby trap late in the design of an exhibit depicting dynamic equilibrium. A feedback system, it employed a variable-strength electromagnet to suspend a metal sphere midair.

A light shone toward a sensor positioned behind the ball. Whenever the ball blocked the beam, the light sensor

sent a signal to the electromagnet to cut its strength. As soon as it did, the ball would fall, permitting the light beam to fully illuminate the sensor. This triggered the device to boost the electromagnet's strength, pulling the ball back up. Museum-goers could block the beam with their hand or grab the ball out of the system and drop it back in.

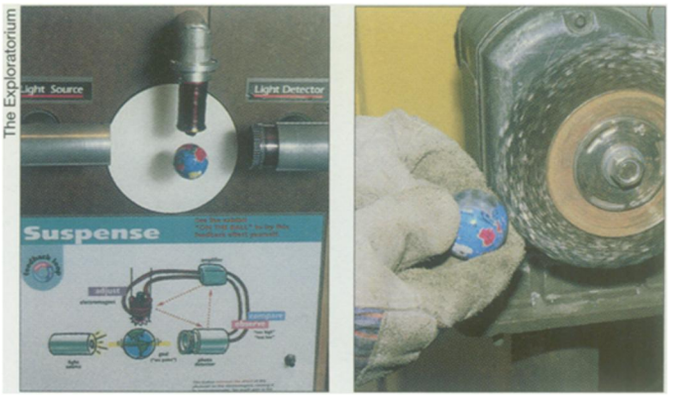
"People learned how to use it the right way and were having fun with it," Allen says. But in speaking with them, she quickly realized that, conceptually, they just "weren't getting it."

The dangling ball—purchased on the basis of its size, weight, material, and low cost—happened to be painted like a world globe. "When we asked visitors what the display represented," she says, "they told us it was obviously a model of the solar system," with the light beam depicting the sun. Many particularly enjoyed the way the floating "Earth" tended to spin in space.

Allen has since stripped the misleading design from the silvery ball.

A somewhat newer type of museum study attempts to determine whether a completed exhibit achieves its intended goals. Visitors leaving a show on women's health, for instance, might be surveyed for evidence that they gleaned the importance of breast self-exams or learned the appropriate way to do them.

This type of summing-up study was conducted in a 30,000-square-foot outdoor physics playground that opened last year at the New York Hall of Science in New York City. Fifth graders were let loose among interactive exhibits designed to demonstrate various scientific principles—from angular momentum and fluid mechanics to levers and energy transfer. None of the 27 different play stations bore signs or labels. Children who used the playground's wave machine, tornado column, or river-diverting stream table, for instance, had to figure out each exhibit's purpose through experimentation, often by collaborating with others.



Evaluators discovered that the earthly paint job that happened to be on a ball in one exhibit misled visitors into thinking they were looking at a model of the solar system (left photo). Now, museum employees strip the paint off of each ball (right)—a task that adds up to a lot of work because visitors pocket dozens of the balls each year.

"We didn't put up any signs, initially, because we wanted to see what type would be most useful," explains Alan J. Friedman, the museum's director. However, the exhibit's evaluation, completed in July, indicates that this wait-and-see approach yielded unanticipated benefits.

Without explanatory labels, Friedman says, "the children felt it was okay to just go out and explore." It now appears that their activities resulted in a sense of personal discovery—making their observations more meaningful, he says.

The museum designers also pondered whether schoolchildren should be prepared by their teachers before field trips to the physics playground. The study concluded that youngsters appreciated their teachers helping them find real-world examples of the playground phe-

JAH Hall/Smithsonian Institution

This globe, depicting Earth's tectonic plates, stopped rotating shortly after the Smithsonian opened a refurbished geology hall. Worried that no one was paying attention to the globe, the museum wondered whether there was any value in repairing it. While evaluators confirmed that museum-goers were largely ignoring the static exhibit, their interviews showed that visitors generally understood plate tectonics. The evaluators suggested that engineers temporarily put the globe back in motion. Right away, people began congregating around it, discussing how tectonic plates move—and thereby justifying the expensive permanent repairs.

nomena, such as whirlpools, spider-web vibrations, and fulcrums—but only after the visit was over. "In hindsight, I probably should have predicted that describing concepts that they were going to encounter wouldn't prove meaningful. Until children have experienced them, it's all too abstract," Friedman says.

Some museums commission studies before any design or construction of an exhibit begins. These survey what a museum's visitors know about some particular topic, including related beliefs, attitudes, or misconceptions.

Although uncommon, this type of evaluation is one "that people are increasingly appreciating," Falk says. Moreover, he adds, "in the long run, it may also be the most cost-effective" because it can ferret out predilections or prejudices that may work for or against a costly project.

Such an evaluation helped shape the retailoring of the Smithsonian's 20,000-square-foot hall of gems and minerals, most of which reopened last year. Some of the visitor-survey data pointed out earth-science concepts that can confuse the public—such as how crystals grow—indicating where more explanations are needed. The surveys also identified topics of intense curiosity, which can be bait for hooking visitors into exploring related ideas. Numerous visitors, for instance, found it incredible that malachite is a crystal, prompting the museum to make the striped, green stones a primary illustration of such microcrystals.

The Monterey Bay (Calif.) Aquarium is among the institutions that have come to rely on such front-end evaluation. Its 1992 jellyfish exhibit exemplifies why.

Early in the show's conceptual planning, some members of the staff voiced serious skepticism about whether the public would come to see jellyfish, recalls Hayward. They suspected that most people view jellies as little more than "worthless blobs of slime."

So Hayward interviewed three groups of prospective visitors. "And indeed," he says, "we confirmed that most people had no interest in an exhibit on jellies."

Instead of using the data to justify shelving the proposed show, Hayward says the museum instead adopted the study's primary finding—that people have little respect for these creatures—as a focus of the exhibit.

When subsequent testing indicated that a beautiful presentation could alter people's attitudes toward the gelatinous zooplankton, the designers turned over one-third of the exhibit to darkened rooms that showcased glowing side-lit jellies. As living art, they floated ethereally to the accompaniment of what Hayward describes as "other-worldly music."

In the end, "Planet of the Jellies" became the museum's all-time top-drawing show. Moreover, once attendees stopped gawking at the graceful animals, "most went on to the science part of the exhibit," Hayward says. The museum "hooked people into the science with beauty."

Similarly, for "Mating Games," a 1994 exhibit on reproduction, "we actually did focus groups, realizing that this was a sensitive topic," recalls Sue Blake, manager of exhibit research and development at the aquarium. "And based on that information from our visitors, we designed the exhibit such that the 'doing it' area was off to one side—so parents could sidestep it if they didn't want children to see it."

One might suppose that museums perform evaluations out of their own need to judge the success of exhibits. And certainly, some of the more progressive institutions act under that incentive, Falk says. "But most have been driven by funding agencies, especially the National Science Foundation," he notes.

The agency's Informal Science Division grants more than $15 million to museums annually. Beginning around 1990, evaluation became an essential ingredient of successful grant proposals. Says Dierking, "You now need to give [NSF] a fairly detailed plan for the evaluation, and they prefer if you actually identify who will be doing it." Many other major museum sponsors have begun instituting similar requirements.

Allen suspects there's a reason why science centers have been in the vanguard of museums embracing evaluation. "Art and history museums tend to focus on preserving and displaying precious objects," she observes. Because the science museums' mission instead centers on "creating some critical core experience for the visitor," she thinks that these institutions feel a greater need for feedback from visitors on the nature of their experience.

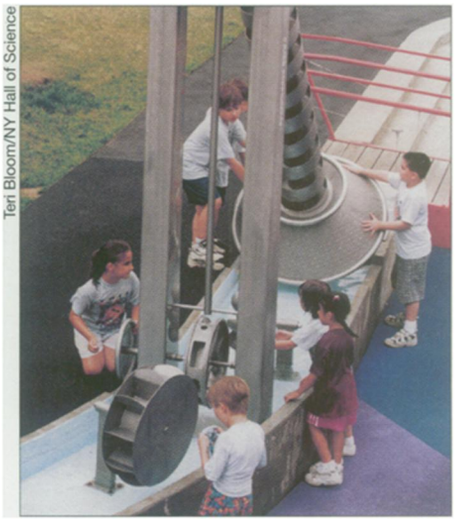
Despite a 70-year history—admittedly thin—and a spate of recent successes, exhibit evaluation remains an evolving process. In many ways, the social scientists who perform it are still exploring not only what types of questions to ask, Falk notes, but also how to ask them and when.

He points out that "we have traditionally viewed [learning] as accumulating new information on top of old. Metaphorically, you can think of this as stacked building blocks, where we gauge learning by measuring increases in the height of that stack."

However, his research indicates that people tend to use museums differently—to confirm or solidify ideas that they already have. "So in some sense, museum learning may not build new height so much as reshuffle blocks near the bottom to make a more secure foundation of knowledge."

Notwithstanding the limitation of current studies, Allen says that "museums are coming to realize that putting their money into evaluation is a good investment; without it you can waste all of your money."

Indeed, McNamara adds, once the staff of a museum have employed evaluation—and seen the difference it can make—most become believers "and realize it's not worth putting together projects any other way." □


Teri Bloom/NY Hall of Science

An absence of labels at the individual stations in this playground prompts children to conduct intuitive inquiries in which they discover physics under the guise of play.