Museums, Communities, and Contemporary Science

Alan J. Friedman

Science museums are a billion-dollar-a-year industry, supported by a mixture of communities: government, corporate, individual, and foundation, as well as the general public. Science and technology centers are a relatively recent subset of the science museum realm, with a specialization on "hands-on" or "interactive" exhibits, and a spectacular record of growth. In 1972 there were 17 institutions that identified themselves as belonging to this category. Today there are 450 such science-technology centers in the world, most of them created within the past 20 years. In the United States alone they draw over 100 million visitors a year.[1]

Along with the generally happy situation, however, there have been some serious questions about the roles and effectiveness of science museums and science centers, and a few disturbing near-failures. A dozen science museums have found themselves in life-threatening situations, most often but not always beginning with overruns in the costs of initial construction or of a capital expansion. These examples of serious problems, facing such well-established museums as the Franklin Institute, the Oregon Museum of Science and Industry, the Smithsonian, and highly promising newcomers like the Columbus Center, Liberty Science Center, and newMetropolis, suggest that it is important not to take community support for science centers and museums for granted. Indeed, some unexpected event, like a cost overrun or a controversial exhibition, may cause the various communities of stakeholders to discover suddenly that they each have wanted different things from these institutions.

This paper discusses four major communities that are critical to science museums, and offers views of where the interests of these communities coincide and where they differ. These four constituencies are scientists, public visitors, funders, and museum staff. This analysis is based primarily on the author's experiences at his own institution and at other U.S. science centers and science museums. The term "science museum" is used here to refer to all types of science-technology museums and centers.

WHAT SCIENTISTS WANT A SCIENCE MUSEUM TO DO

Scientists and scholars want to educate the public about the fundamentals of their fields. They want museums to explain the processes through which science creates and learns. They want to celebrate the achievements, both historical and contemporary, of which they are most proud.

Scientists and curators also want contemporary science content. The major events of 20th-century science, including relativity, quantum theory, DNA, and the expanding universe, are among the topics that scientists believe should be covered.

WHAT VISITORS WANT A SCIENCE MUSEUM TO DO

The public that visits museums is not, in general, looking to learn any specific information. Family visitors say they want a pleasant, entertaining afternoon together. Individual communities want to see celebrations of science and technology related to their own culture and history. There is one overriding demand: to explain how the subject directly relates to the visitor's own life, and what the visitor already knows and is interested in.

When the New York Hall of Science did extensive "front end" evaluation for an exhibition on microbial life, and another on chemistry, we learned that visitors were almost exclusively interested in those microbes that they had heard about in the mass media recently, such as the viruses which caused AIDS, or which had affected them directly, such as the common cold. Visitors were also interested in the chemistry of their own bodies. They did not volunteer a strong desire to learn about the underlying principles, the classifications and terminology, or the processes of investigation that scientists used to learn about microbes.

WHAT FUNDERS WANT A SCIENCE MUSEUM TO DO

In general, funders want to be associated with excellence and success. An institution with strong visitorship, an excellent public reputation, and a healthy financial situation is likely to attract government, business, and individual support. The funders want their own judgment in recognizing excellence, and their generosity, to be recognized and celebrated as well.

Beyond these general attributes, however, funders are also looking for institutions to contribute to the quality of life of their communities in several specific ways. The government of New York City, for example, is most impressed by the role museums play in stimulating the City's economy. The Cultural Institutions Group of New York City, which represents 34 museums receiving the most funding from the City, estimates that the US$ 84 million that City government spends on these museums plays a key role in generating US$ 2,000 million in economic activity. This activity includes the direct and indirect impact of spending by the institutions themselves, and increased tourism.

Quality cultural institutions also contribute to the residents' sense of well-being in their neighborhoods, making people happier to live in a particular region. This argument is appreciated by corporations that want to attract and retain employees, and it is appreciated by businesses such as real estate investors.

WHAT STAFF WANT A SCIENCE MUSEUM TO DO

The museum exhibits and education staff of science museums are acutely if quietly aware of the limitations of the exhibition medium. First, many exhibit developers hold that what counts is not what was *intended* by a design, or even what an exhibition *presents*, but only *what the visitor actually takes away from the experience*. Science-technology museum visits typically last one to three hours; individual exhibit units typically hold visitors for between 30 seconds and 3 minutes. Within these constraints, exhibits can make limited (if lasting) impacts on visitors' knowledge and attitudes.[2]

Exhibits can be expected to communicate only simple stories. "Hands-on" exhibits are best at presenting the sensory impact of real objects and phenomena. You can see, hear, and smell the spark from a Van de Graff generator; feel the effect of a compound pulley; watch in real time the unpredictable life and death of individual microbes. Simply putting a phenomenon or object on display celebrates it, but usually fails to be effective in placing a phenomenon in a broader or deeper context. Exhibitions that try to do too much may only confuse or intimidate most visitors, who enter a science museum somewhat timidly anyway.

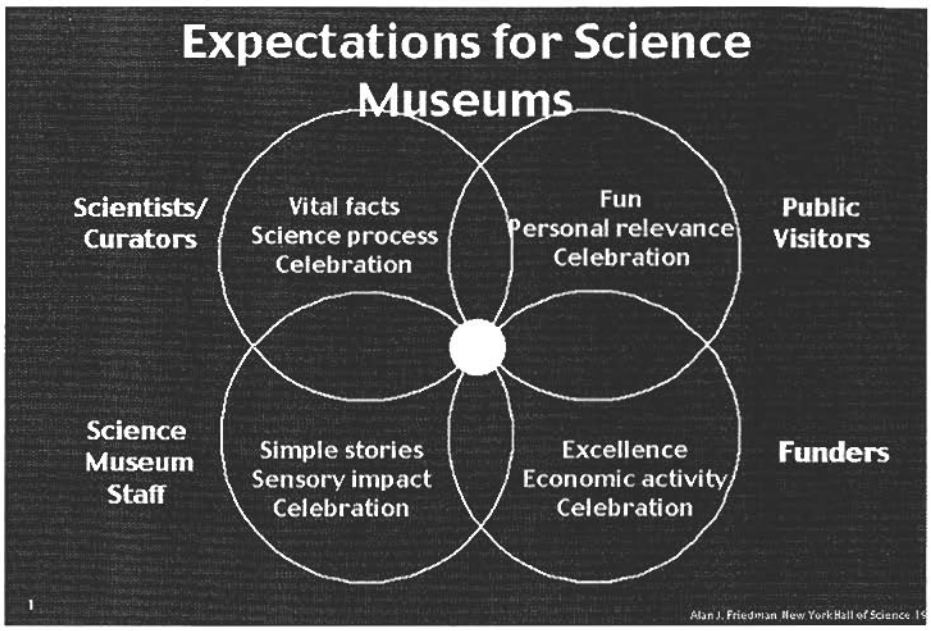


CHART 1.

WHERE THE EXPECTATIONS OF THESE FOUR COMMUNITIES OVERLAP

These four sets of expectations overlap primarily in the word "celebrate" (**Chart 1**). When they find the right things to celebrate, science museums have a chance of pleasing everybody a little bit, even if they reach only a small part of the full potential each of the stakeholders wants to achieve. Most science museum exhibits today are, indeed, celebrations of some object or phenomenon. Celebratory exhibits normally present little controversy, but these exhibits also usually present little contemporary science, little opportunity to understand the processes of science, little of the broader context that may be required to make the subject of an exhibit truly important.

COMPONENTS OF EXHIBITIONS THAT PLEASE EVERYONE

Gyroscope (Figure 1, at Techniquest in Wales): The bicycle wheel gyroscope celebrates a very

FIGURE 1. Bike Gyro exhibit at Techniquest, Wales.
Photo: Alan J. Friedman

fundamental phenomenon, and because it behaves in an unexpected manner, the device also delights visitors. Industrial applications of the gyroscope are part of several major achievements in contemporary technology.

Soap Bubbles (Figure 2, at the New York Hall of Science): Making giant bubbles illustrates several important phenomena, although few visitors know the language scientists use to describe those phenomena. Nevertheless, the popularity of bubble phenomena is strong among the public because the sense of accomplishment, esthetics, and connections to everyday experiences make the bubbles accessible to everyone.

Catenary Arch (Figure 3, at the Exploratorium in San Francisco): Like the gyroscope, arch bridge exhibits, both large and small, demonstrate something important in science and mathematics,

FIGURE 2. Soap Bubbles exhibit at the New York Hall of Science, part of the *Seeing the Light* exhibition created by the Exploratorium, San Francisco.
Photo: Ken Howard

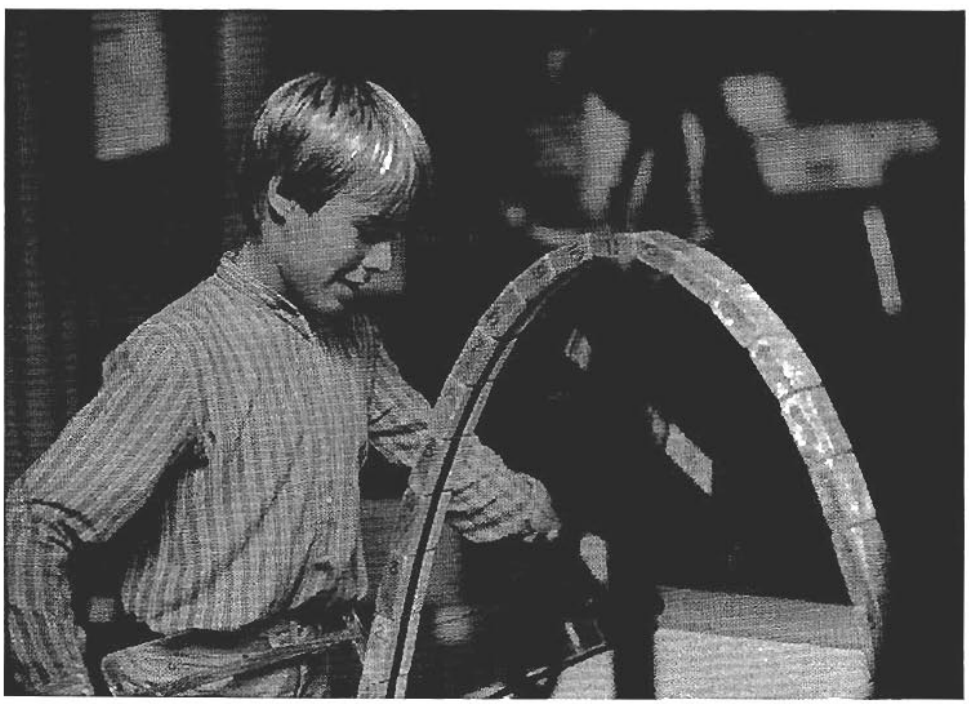


FIGURE 3. Catenary Arch exhibit at the Exploratorium, San Francisco.
Photo: Alan J. Friedman

with successful applications in industry and in everyday life.

EXHIBITIONS THAT FAIL TO MEET THE EXPECTATIONS OF ONE OR MORE COMMUNITIES

Quantum Atom Model (Figure 4, at the New York Hall of Science): A three-dimensional, interactive, dynamic model of quantum energy states of a hydrogen atom is very pleasing to scientists and serious students, but has proven to be difficult for the general public to appreciate or interpret. Too much prerequisite knowledge is required to understand why quantum theory was so surprising to scientists early in the century, and why the behavior it depicts is so radical and important to our understanding of the universe. The major intellectual achievement this concept represents is largely unknown to visitors. Visitors lacking some prior awareness of the revolutions in twentieth-century physics have a difficult time understanding what all the fuss is about.

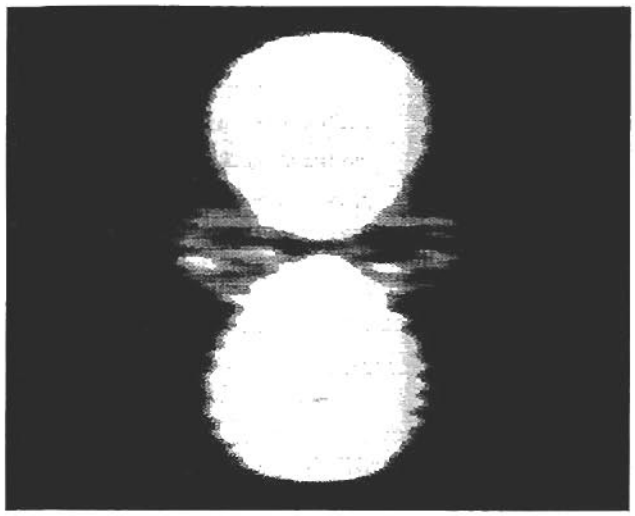
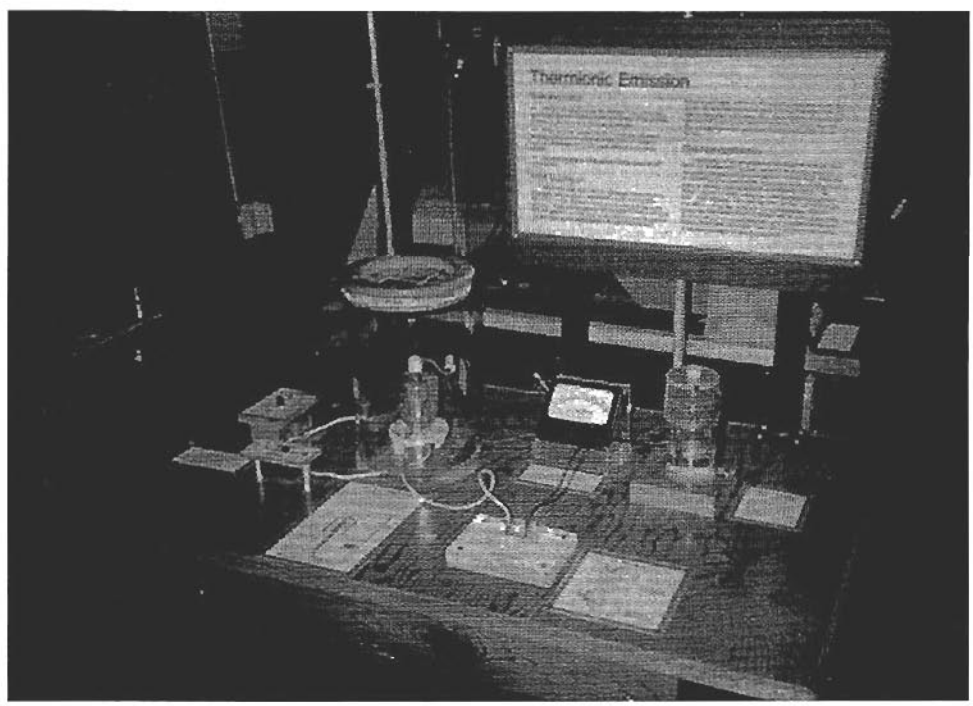


FIGURE 4. Quantum Atom Model, part of the *Realm of the Atom* exhibition at the New York Hall of Science.
Photo: Alan J. Friedman

Einstein (Figure 5, at the Exploratorium in San Francisco): Despite Einstein's fame and personal attractiveness to the general public, it has proven extraordinarily difficult to explain what he did to non-scientists. The science center most accomplished in presenting real phenomena in accessible form, the Exploratorium, was able to produce very little in the way of demonstrating Einstein's work itself. Its Einstein exhibition primarily presented phenomena that exposed inconsistencies in 19th-century theories. Most visitors, however, were equally unfamiliar with either 19th-century or 20th-century physics. Like the quantum atom model,

FIGURE 5. "Thermionic Emission," part of the *Einstein in Context* exhibition at the Exploratorium, San Francisco.
Photo: Alan J. Friedman



this exhibition is pleasing to scientists but of little interest to most of the public.

Enola Gay (Figure 6, at the Smithsonian's Air and Space Museum): The *Enola Gay*, the airplane that dropped the first atomic bomb on Hiroshima, is a concrete object representing a pivotal event in 20th-century history and in the entire history of the relations between science and society. The Smithsonian Air and Space Museum's attempt to place this object in a cultural and historic context led to threats to cut off government funding and eventually resulted in the resignation of the museum's director and the presentation of the airplane in a practically "interpretation-free" exhibition. While there were real intellectual disagreements about the best interpretation of the Hiroshima bomb, the failure of this planned exhibition was largely due to its failure to fit within the "celebration" expectation that funders and some sectors of the public audience regarded as the primary mission of this museum.[3]

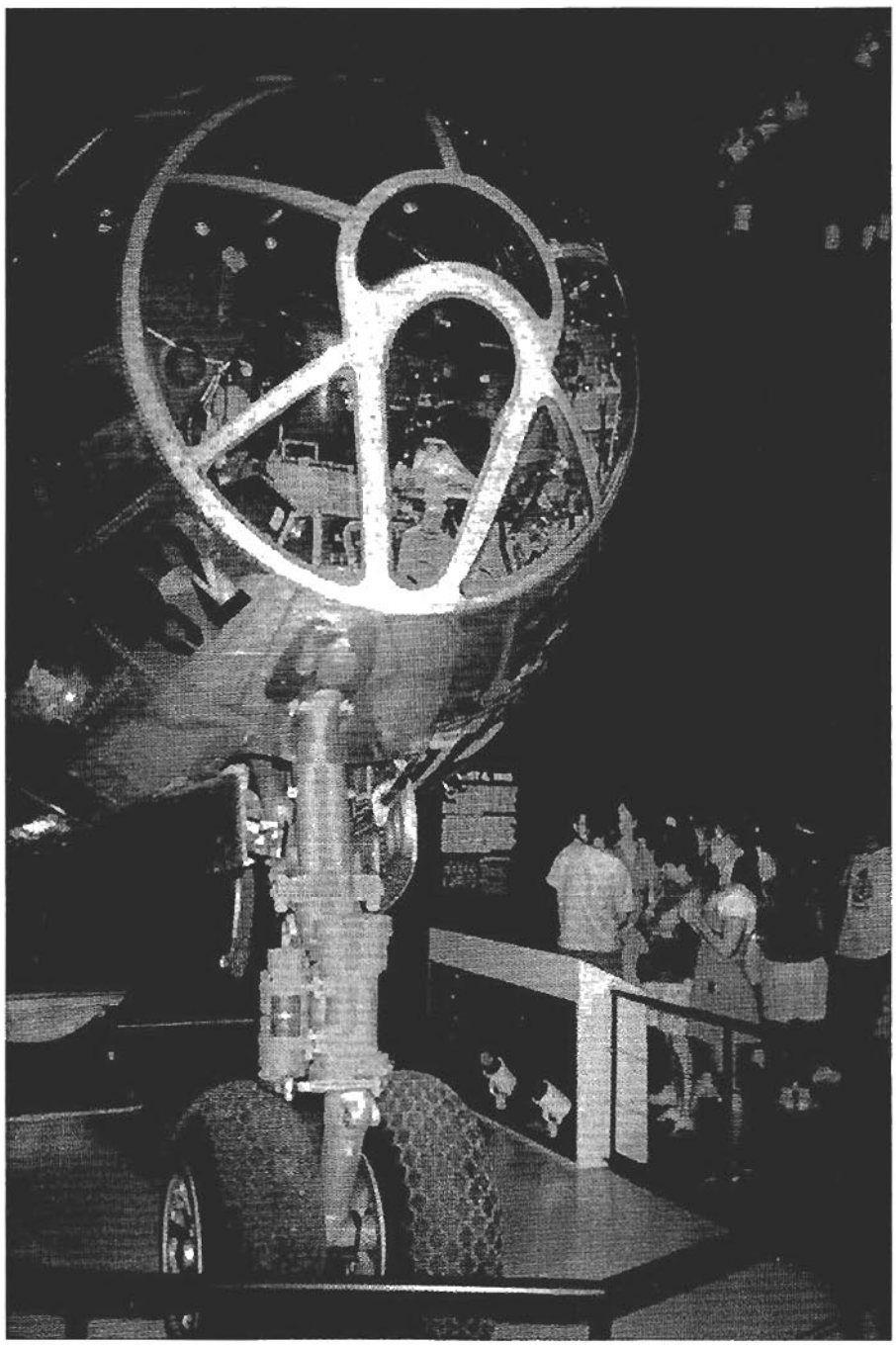


FIGURE 6. Enola Gay aircraft, part of the *Enola Gay* exhibition at the Smithsonian National Air and Space Museum, Washington, DC.
Photo: Alan J. Friedman

Science in American Life (Figure 7, at the Smithsonian's Museum of American History): This exhibition, like the planned *Enola Gay* exhibit, had similar problems. The curators had a particular view of one aspect of science in American life, a view that stressed the public's increasing disenchantment with science and technology as "cure-alls" for social problems. The major non-government funder of the exhibit, the American Chemical Society, had expected a celebration of the accomplishments that science had in fact achieved during the history of the United States, and were disappointed with the preponderance of negative examples that the curators used to make their more tightly focused interpretation clear. Members of the American Physical Society, a group of scientists who had not been funders, were even more outspoken in their criticism, vigorously articulating the view that the function of museum exhibitions is solely to celebrate accomplishments. While visitors to the museum were overwhelmingly pleased with the exhibition, rarely noticing its underlying theme, the unhappiness of scientists and scientist/funders created significant commotion and threats to the museum's funding.[4]

COMMON CHARACTERISTICS OF "SAFE" EXHIBITIONS

Success or disappointment with any given exhibition may certainly be related to the particular execution of that project, as well as its more generic properties. Such limitations notwithstanding, most successful universally pleasing science and technology center style exhibits have been essentially *non-verbal, non-sequential* experiences for visitors. In this fashion, they are more like art museums. Works of art themselves are largely meant to be non-verbal, non-sequential; so art museums can function merely by placing objects on walls, with little or no signage or context. The same thing can be done with the phenomenological exhibits at science-technology centers.

But science, especially contemporary advances in science of the type that win Nobel prizes, and understanding of cultural or historic context, are highly verbal (the language is sometimes mathematics) and require prerequisite, sequential knowledge to be understood. Objects like a computer chip, a telephone switching station, a recombinant

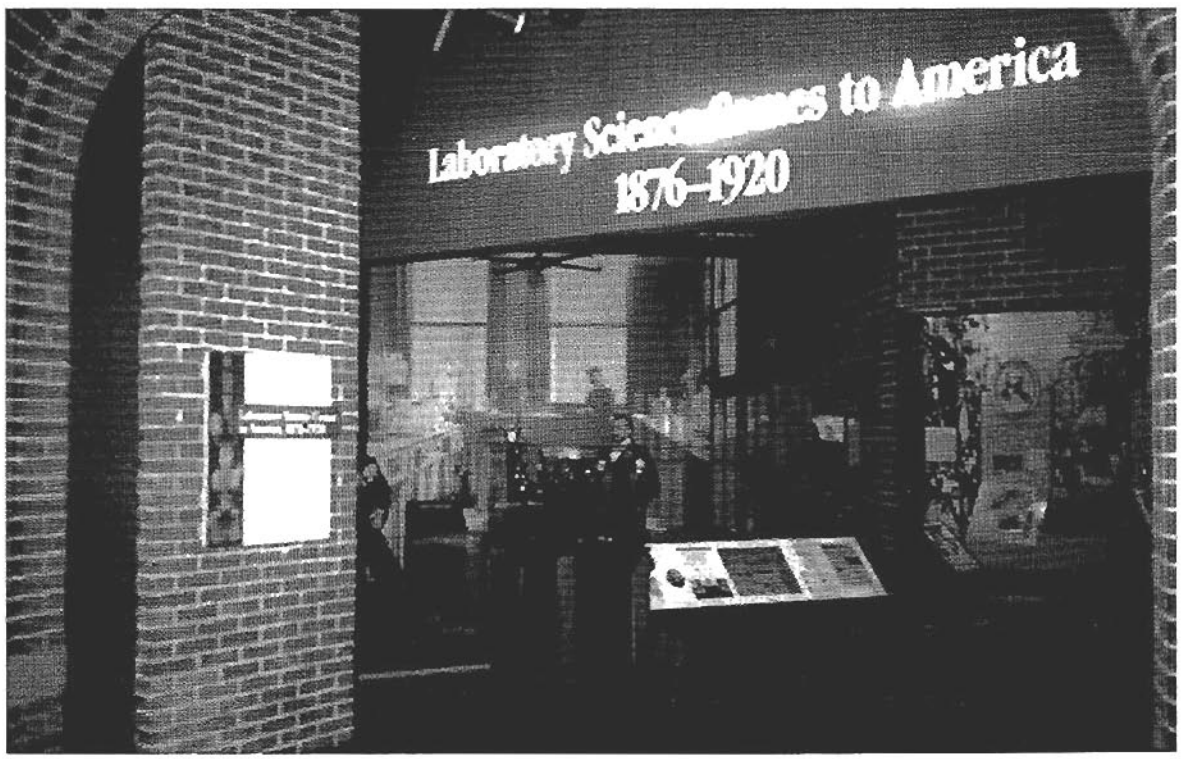


FIGURE 7. Laboratory Science Comes to America/1876–1920, a section of the *Science in American Life* exhibition, Smithsonian National Museum of American History, Washington, DC. *Photo: Alan J. Friedman*

DNA laboratory, or a theoretician's brain do not "speak for themselves." So science-technology museums, and science centers in particular, have a very difficult time presenting contemporary science, the process by which science is done, or ideas about social context.

SUGGESTIONS FOR MOVING BEYOND CELEBRATION

There are many topics and goals for exhibits sought by scientists, scholars, funders, and the public that are extremely difficult if not impossible to communicate through the exhibit medium, and perhaps are just better suited to books, television programs, or formal classrooms. Nevertheless, science museums, to meet their own ambitions and those of their constituent communities, are attempting to move beyond celebration. One strategy to handle difficult topics and goals, including prerequisite knowledge and sequence, is to create simulations or even theme park rides, to impose an order to the visitor's experiences. But these presentations usually have low "reality quotients": visitors learn mostly about the rules of the simulation, not the rules of nature. These exhibitions may also break faith with the visitor's expectation that, in an informal learning environment, it is the visitor who should control the order and timing of the experience in the museum.[5]

There are, however, some possible solutions available that use science-technology museum strengths and still communicate effectively verbal, sequential stories:

- the use of multiple media so that the physical, three-dimensional objects in an exhibition and the labels do not have to carry the sometimes impossible burden of satisfying conflicting expectations. Random access and layered audio tours (**Figure 8**, New York Hall of Science), live tours, theatrical presentations on the exhibit floor; all allow more complex, multiple verbal perspectives to be offered and multiple agendas to be addressed, and early controlled experiments suggest these techniques can be effective.
- the creation of guided, longer duration, but still free-choice experiences, such as the experimentation galleries at the Boston Museum of Science and the Science Museum of Minnesota.
- exhibitions that make use of the social interactions among visitors and among visitors and staff, to explore contexts and controversial issues. "Mine Games" at Science World in Vancouver **(Figure 9)** has demonstrated the possibility of effectively dealing with conflicting interpretations

FIGURE 8. Visitors in the Seeing the Light exhibition at the New York Hall of Science, using a random-access audio tour during an evaluation study.
Photo: Teri Bloom

FIGURE 9. Section of the Mine Games exhibition at Science World, Vancouver.

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and biases in contemporary issues where science, technology, and other communities of interest meet.

Science museums are learning, albeit slowly and with some pain, how to combine the pleasures and successes of science-technology museum exhibitions with the inherently verbal, sequential structures required to go beyond the desirable but limited goals of celebration of science and of nature.

NOTES

A shorter treatment of this theme was given by the author for a panel at the 1998 meeting of the American Association for the Advancement of Science.

1. *Yearbook of Science-Center Statistics* (Washington: Association of Science Technology Centers, 1997), p. 19.
2. Valerie Crane, Heather Nicholson, Milton Chen and Stephen Bitgood, *Informal Science Learning* (Dedham, MA: Research Communications, 1994), pp. 61–106.
3. Mike Wallace "The Battle of the Enola Gay," *Museum News* (July–August 1995): 40–45, 60–62. See also Martin Harwit, *An Exhibit Denied: Lobbying the History of Enola Gay* (New York: Copernicus Books, 1996).
4. Jane Gregory and Steve Miller, *Science in Public* (New York: Plenum Press, 1998), pp. 214–219. See also Robert L. Park and Ursula Goodenough, "The Unmaking of American Science Policy: The End of the Scientific Era?" *Academe*, (January–February 1996): 15; Andrew J. Pekarik, Zahava D. Doering, and Adam Bickford, "An Assessment of the 'Science in American Life' Exhibition at the National Museum of American History," Institutional Studies Office, Smithsonian Institution, Report 95-5 (November 1995); Joan E. Shields, "Science in American Life Revisited," *Chemical and Engineering News*, (March 11, 1996): 40; Alan J. Friedman, "Exhibits and Expectations," *Public Understanding of Science*, Vol. 4 (1995): 305–313.
5. Alan J. Friedman, "Differentiating Science-Technology Centers from Other Leisure-time Enterprises," *ASTC Newsletter*, 24, No. 1 (1966): 7–10.