Summative Evaluation

Engaging Public Audiences in Current Health Science

at the Current Science & Technology Center

Museum of Science, Boston

Funding provided by a Science Education Partnership Award (SEPA R25 RR15653) from the National Center for Research Resources, National Institutes of Health

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i. Executive Summary

In April 2001, the Museum of Science in Boston launched the Current Science & Technology Center,[1] an effort to engage public and school audiences in leading edge research and to provide depth and context for science and technology stories in the news within a museum context and through various outreach methods. Health science programming in the CS&T Center is researched, produced and delivered to primarily public audiences in partnership with selected New England area medical and public health schools, teaching hospitals, and biomedical research institutes. This Health Science Education Partnership (HSEP) is funded by SEPA grant #R25 RR15653 from the National Center for Research Resources at the National Institutes of Health. The Museum of Science (MOS), in collaboration with the Institute for Learning Innovation (Institute), initiated a multi-year evaluation effort designed to support the Current Science & Technology Center and its Health Science Education Partnership through (1) the monitoring and evaluation of CS&T's several modes of education and outreach; (2) the establishment of a baseline understanding of how a consortium of research organizations working with a major science museum can help facilitate public interest in and understanding of research and stimulate further learning and dialogue, and (3) a comprehensive assessment of the efficacy of the CS&T project as a whole, and the HSEP partnership in particular.

This summative evaluation report will focus on the audience perceptions and outcomes, and on the partnership between the museum and participating individual scientists and supporting institutions. The guiding question is: *Does CS&T provide an effective mechanism for communicating current health science research in a science center setting?*

CS&T and the Health Science Education Partnership were engaged in a wide range of ambitious public engagement activities, not all of which could be assessed within the scope of this summative evaluation study. These included short-term exhibits, live cablecasting through New England Cable News, multimedia story production and distribution through digital displays in multiple museums and on the World Wide Web. This summative evaluation focuses on audience experiences within the museum itself and on the perspective on the partnership by outside partners. Other areas were addressed with formative and remedial evaluations.

The study is based on post-only, face-to-face exit interviews of museum visitors and visitors to CS&T, written feedback from visitors who attended various types of presentations on the multimedia stage of CS&T, face-to-face and telephone interviews and a focus group with partnering scientists and institutions, and unobtrusive observations. All interviews were structured to collect both quantitative and qualitative data. Rating scales, forced choice questions, and open-ended questions were mixed and partly triangulated. Visitor feedback was based primarily on self-report items. Learning outcomes were assessed through self-report items. Visitor behavior was studied using unobtrusive, structured observations ("tracking"). Respondents were tracked throughout their stay in the gallery, and their engagement and social interaction behavior was recorded at each exhibit.

Does CS&T provide an effective mechanism for communicating current health science research in a science center setting? This was the major research question behind the evaluation and the results of this study indicate that it does. CS&T utilized a variety of communication means, including staged live events of various types, exhibits, touchscreens, a website, a newsband and cablecasting to a regional news channel to communicate current health science in more depth than most electronic media outlets have the resources to do, and offers this information in several free-choice learning formats. The evaluation was

[1] Renamed in 2006 as the Gordon Current Science & Technology Center.

restricted to assessing the impact of live events (presentations on the media stage), exhibits and touchscreens on target audiences, and only gathered cursory data on website use and the reach and impact of the cable news interview segments. However, formative evaluation data suggested that live events were a powerful mechanism to communicate with the museum audience, and that the exhibition portion of CS&T was successful in engaging a smaller percentage of museum visitors in a serious and advanced conversation about current topics of science and technology. The data also suggest that CS&T needs more time to brand itself within the Museum community and the community of the science and health-attentive public. CS&T is not yet known well enough amongst potential target audiences to develop its full potential.

CS&T as a model would not have been as effective as it was without the support of outside partners. The partnership that was forged between major science and health institutions and media outlets in the Boston area and CS&T added enormous value to the programming of CS&T, both on stage as well as in the exhibition area. In particular, the partner liaisons were helpful in identifying researchers on their staff who could speak in an engaging way for public audiences. The partnership also needed strong support and nurturing, and the evidence suggests that it was not used to its full potential. Some partners felt that there was not enough communication and feedback between the Museum and the institutional partners. The partnership was generally assessed in positive terms. Some partners felt that the benefits of the partnership were worth the effort and they would recommend this type of cooperation to others. Other partners were not satisfied with the results and questioned whether their contribution was needed or of sufficient value. Since the official partner interviews were conducted, some of the partners who were more critical than others have expressed greater satisfaction with the project in subsequent conversations. Managing a partnership amongst so many different institutions necessitates considerable effort on the side of the Museum, and it is essential that sufficient resources be devoted to communication and coordination.

Some elements of the project cannot easily be adopted by others. The scientific journals involved in this partnership made it abundantly clear that they would only be able to work with a small number of highly trusted science museums on the issue of embargoed information. Some of the institutions also indicated that part of the value for them lay in the visibility that a partner like the Museum of Science, Boston, provided them with. Smaller, lesser known science museums and similar institutions may not bring that asset into a partnership with nationally acclaimed science research institutions and journals, though local partnerships on a smaller scale may not need it. The project suggests a different format for a national system that imitates the partnership formed between CS&T and the Museum of Science with its institutional partners. Few local hubs in major cities could be supported this way, and provide content for similar partnerships or individual science centers across the country. While there are numerous obstacles to such a system, the Museum of Science has already tested and found that educational media content can be shared amongst non-competing science museums and science centers.

The project relied partially on the enthusiasm of numerous scientists in the Boston areas who were willing to present their research to an interested and attentive public. All of the participating scientists expressed satisfaction with their involvement in CS&T; more so, all of them considered their role as important and felt that it strongly overlapped with their professional interests. CS&T provided an excellent opportunity for these scientists to communicate their research to an attentive public, and it allowed emerging scientists who participated as PhD students or post-doctoral fellows to hone not only their public speaking skills, but their overall ability to discuss their research within a larger context.

Partnerships between science centers or science museums and local universities and research centers (and thus local scientists) would likely be beneficial in many cases, though, again, the data suggest that it takes time and effort to ensure that the results would ultimately be as positive as they were and are in this project. Not every scientist is capable of translating his or her research to a general audience of interested

laypeople, and not every museum staff member is capable of coaching scientists to communicate successfully with public audiences. Also, it takes effort, knowledge and skill to find and select those who will successfully present their science to a general audience. Conversely, it takes an institution of the caliber of the Museum of Science to attract the best scientists and to ensure that they believe the project worth their time and effort. However, the data indicate that it is far more accepted than even a decade ago that scientists, even those who still need to establish themselves within their own community of practice, are interested in honing their skills in science communication and that their efforts in this regard are accepted amongst their peers.

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1. Introduction

In April 2001, the Museum of Science in Boston launched the Current Science & Technology Center, an effort to engage public and school audiences in leading edge research and to provide depth and context for science and technology stories in the news within a museum context and through various outreach methods. This was one of the first experiments of its kind in any informal science education institution anywhere and was the first to combine a daily schedule of live presentations, short-term exhibits, web and new media. Within the first two years of its inception, the Center was recognized as a "Best Practice in Communicating Science and Technology to the Public" by a Department of Energy and National Institute of Standards and Technology panel, and was awarded the gold "MUSE" award for innovative use of media and technology in museum settings by a committee of the American Association of Museums. Although the National Science Foundation had not contributed funding to the development of the CS&T Center, NSF invited the NIH-NCRR-SEPA Principal Investigator and CS&T Manager, Carol Lynn Alpert to participate in several panels on public understanding of research (PUR) in the U.S. and in Japan, and the Center was featured as a case study in an NSF funded PUR conference, which later resulted in a chapter in the book "Creating Connections: Museums and the Public Understanding of Research."[2] The CS&T model for communicating current science had thus received considerable attention even before a summative evaluation of the Center was completed.

Health science educational programming in the CS&T Center is researched, produced and delivered to public and school audiences in partnership with selected New England area medical and public health schools, teaching hospitals, and biomedical research institutes.[3] This Health Science Education Partnership is funded by SEPA grant #R25 RR15653 from the National Center for Research Resources at the National Institutes of Health. The Museum of Science (MOS), in collaboration with the Institute for Learning Innovation,[4] initiated a multi-year evaluation effort designed to support the Current Science & Technology Center and its Health Science Education Partnership through (1) the monitoring and evaluation of CS&T's several modes of education and outreach; (2) the establishment of a baseline understanding of how a consortium of research organizations working with a major science museum can help facilitate public interest in and understanding of research and stimulate further learning and dialogue, and (3) a comprehensive assessment of the efficacy of the CS&T project as a whole, and of the HSEP partnership in particular.

During the first three years of the project, CS&T staff and researchers from the Institute for Learning Innovation jointly conducted a variety of front-end, formative and remedial research projects provided CS&T staff with feedback on

- communication of current science in museums settings (front-end literature review);
- label writing for science museum exhibits
- staff presentations on the multimedia stage
- science theatre/forum presentations on the multimedia stage

[2] Alpert, C.L. (2004). Bridging the Gap: Interpreting Current Research in Museum Settings, In Chittendan, D., Farmelo, G. & Lewenstein, B.V. (eds.): Creating Connections – Museums and the public understanding of research; pp. 235-256. Walnut Creek, CA: AltaMira Press.

[3] Harvard Medical School, Harvard School of Public Health, the Whitehead Institute for Biomedical Research, Massachusetts General Hospital, the Dana-Farber Cancer Institute, McLean Hospital, and the Harvard-MIT Division Health Science and Technology Program.

[4] The Institute for Learning Innovation is an Annapolis, MD-based not-for profit research and evaluation organization that focuses on free-choice learning. The Institute provided comprehensive evaluation support for the project.

- guest speakers on the multimedia stage
- use of touchscreens in the exhibition area of CS&T.

This summative evaluation report will focus on the audience perceptions and outcomes, and on the partnership between the Museum and participating individual scientists and supporting institutions. The overarching guiding question is: *Does CS&T provide an effective mechanism for communicating current health science research in a science center setting?* In an attempt to answer this question, this report will identify specific target audiences and discuss realistic outcomes that can be expected from what is generally a brief, free-choice learning experience (see Falk & Storksdieck, 2005; Storksdieck & Falk, 2004 and Dierking et al., 2002 for discussions of outcomes in science museums).

I. Background and Description of the Current Science & Technology Center

In recent years, informal science education centers such as science museums have taken an increasingly important leadership role in complementing the role of school curricula and the popular media in informing K-12 students and the public on areas of scientific knowledge and research.

However, with the expansion of the public and privately funded science and technology enterprise and the growing pace of acquisition of knowledge in all fields of science and technology (largely due to advances in technology and computing), it has become increasingly difficult to keep science curricula up-to-date as well as science museum exhibits, which, because of their long-standing emphasis on interactivity, require years to plan, prototype and build. The Current Science & Technology Center at the Museum of Science was an attempt to develop a new exhibit paradigm for science museums in consonance with these new conditions, where the investment would go into a media and infotech-heavy infrastructure to support rapid updating of exhibits, presentations, and digital content, and funding sufficient staff to develop and produce new content in response to recent research and science news.

With that aim, the Museum of Science built a high-tech presentation stage equipped with rapid access to digital graphics, video, live communications links, and other visualization tools. The exhibit area was furnished with flexible, reconfigurable kiosks and exhibit display cases, and a networked system of distributed software allowing for daily updating of content. The CS&T Center also launched a website and later began cablecasting through New England Cable News. To provide for the staffing necessary to research and develop new content weekly, the Museum sought grants in the area of informal science education and partnerships with government-funded science research centers. The most comprehensive of these partnerships, the Health Science Education Partnership, was funded for five years by the SEPA program at the National Center for Research Resources at the National Institutes of Health, beginning in 2000, the first year that informal science learning centers were encouraged to apply to participate full-scale in the SEPA program.

Setting

The centerpiece of CS&T is a high-tech presentation stage equipped with instant access to digital graphics, video, live communications links and other visualization tools. The exhibit area was furnished with flexible, reconfigurable touchscreen kiosks and a networked system of distributed software allowing for daily updating of content. The CS&T Center also launched a website (www.mos.org/cst) and is cablecasting regularly through New England Cable News (NECN).

CS&T informs primarily public and to a lesser degree school audiences on current science and technology mainly through the following avenues:

Multimedia stage

- Staff presentations on the multimedia stage (15-20 minute presentations, followed by a Q&A session and an opportunity for visitors to ask further questions on stage after the Q&A session).
- Facilitated guest researcher appearances on a range of current science topics. These are similar to staff presentations, but last between 30 to 60 minutes. The guest speakers are introduced by CS&T staff, and are sometimes joined on stage by a CS&T staff member.
- Theater-like presentations by Museum of Science actors on values questions associated with current science, technology and/or health-related issues, followed by forum-style audience discussion.
- In-between live events, the screens of the multimedia stage carry short documentary features on science and technology, often related to the exhibit on display or live NASA satellite programming.

Frontiers of Health Science speaker series

The Frontiers of Health Science speaker series is a free event offered through the SEPA grant and held in a self-contained room where food can be served. A setting apart from the Blue Wing and the open CS&T space was believed to provide for a more intimate setting that would encourage discussion and offering food would make it easier for people to attend during the early evening hours. The series featured local scientists from universities, teaching hospitals, and research centers. It regularly attracted between 40 and 120 visitors. Doors opened at 6:15 PM and a ~30 min presentation started at 6:45 PM, followed by discussion and refreshments and informal conversation until 8:30 or 9:00 PM. The series was advertised via a Museum E-news list, posters in the Museum, a poster e-version sent to partners for distribution, press notices sent to the Boston Globe via the Museum Media Relations Department, and the CS&T website. The Frontiers on Health Science speaker series was not formally assessed for this report, although data from feedback forms collected and summarized by CS&T staff indicate a high level of satisfaction with the events by visitors and a high rate of return visitors.

The *Frontiers* series is supplemented by additional programming like "Urban Health Day," a half-day event on a Sunday in May in the Current Science & Technology Center that covered diseases like obesity, diabetes, and asthma with disproportionately high incidence rates in urban settings. The event featured a keynote address and a discussion on prevention strategies with scientists from local health research institutions. Other such events took place during the year, including a "Women in Science Day."

The CS&T "exhibition area"

CS&T is an open physical space without clearly defined borders. It is located in the center of the first floor of the Museum's Blue Wing and is roughly delineated by the media stage, the escalators leading to the second floor, the back wall (harboring CS&T's computer control center and featuring a CS&T logo) and exhibition halls. The "front" and "back" of the space features LED newsbands, located right beneath the open walkway of the next (upper) floor. The newsbands feature current science and technology news. The multimedia stage and its seating area use about a quarter of CS&T's overall floor space; the rest is available for exhibit objects, multimedia touchscreens and interactives, all of which are placed to allow considerable visitor traffic flow through the CS&T space (visitors who are heading to other exhibits located on the same floor).

During most of the period data was collected for this report, CS&T featured a variety of objects as part of a changing exhibition on new medical technologies. The objects, such as the Abiocor™ implantable replacement heart, are often referenced during stage presentations. They are also further explored on the touchscreen displays, with short video pieces, animation, and graphics. Two touchscreen displays are embedded in an exhibit area of CS&T, one below the escalators that addresses astronomy, astrophysics,

and space exploration; the other three are located centrally within the CS&T space as a triad. All five touchscreens carry current science and technology multimedia stories and newsbytes, which are also uploaded to CS&T's website. The touchscreens allow visitors to subscribe to an email alert list.

The CS&T website and newsletter
The CS&T website (http://www.mos.org/cst/) provides a selection of the latest stories and "news bytes" on science and technology in the news, expanded web-versions of the touchscreen stories with live links to research centers, an archive of previous such stories, and offers an updated schedule of CS&T exhibitions and live events. An electronic newsletter, emailed to subscribers, informs about latest events at CS&T. The website is structured similarly to the touchscreens located in CS&T and provides largely overlapping, though expanded information, with live links to research labs and other resources.

Cablecasting through New England Cable News
CS&T staff are interviewed live on camera through an optical fiber link to the multimedia stage by NECN news anchors during a morning news program of NECN that is repeated throughout the day. CS&T staff interpret recent news on science, health, and technology with explanations and additional video, graphics, and demonstrations, also frequently providing insight into the "science behind the news." New England Cable News is available to an estimated 2.8 million homes and businesses throughout greater New England.

II. Project objectives

1. Overall project objectives

The Current Science &Technology Center's *Health Science Education Partnership* was formed with the overall goal of enhancing public understanding of current health science research and its findings. CS&T established specific target audiences for their outreach efforts: the general public and school group visitors to the museum over the age of twelve, and general audiences reached through programs, websites, New England Cable News and other outreach efforts. Across the scope of the activities associated with the partnership, program partners sought to achieve the following Content Goals:

1. Increase public understanding of significant areas of current research in biomedicine, biotechnology, and public health, as well as the implications of such research.
2. Encourage citizens to consider research findings in making healthy lifestyle choices.
3. Interest K-12 students in pursuing careers in these fields.
4. Foster an informed and continuing public discussion on the social and ethical ramifications of new research in the life sciences.

Not explicitly stated, but certainly an important corollary to the Center's work is enhancing public support for ongoing health science research.

The Process Goals of the Current Science & Technology Health Science Education Partnership were to:

1. Develop a highly successful and duplicable model for educating the public and K-12 students in the methods, directions and findings of contemporary biomedical and public health research.
2. Explore new means of partnering with research institutions in creating programming that brings the excitement of research at the cutting edge to broad and diverse audiences.
3. Develop methods of evaluation that contribute to continuing development, refinement, and improvement of the educational model.

4. Report on and disseminate findings widely to the national community of science and technology centers, science educators, and research institutions.

2. Evaluation goals and target audiences

The evaluation of the Current Science & Technology Health Science Education Partnership was linked to the performance and efficacy of CS&T as a whole. Since CS&T was an evolving experiment in current science and technology communication within an established science museum, initial audience research was devoted to helping CS&T leadership and staff improve the various offerings to visitors. Formative and remedial evaluation focused on improving the various life event, exhibit, and media formats. Considerable effort was devoted to training CS&T staff in formative and remedial evaluation techniques so they could gain valuable feedback on an ongoing basis on anything from labels to multimedia stories.

The summative evaluation translated the Content and Process Goals into concrete outcome measures, focusing on those aspects that spoke to the impact of CS&T-related experiences on visitors and on the experiences of participating scientists and institutions.

<u>CS&T and Museum visitors – audience response and audience behavior</u>

- Who are the visitors to CS&T? What is their demographic and psychographic profile?
- What do visitors take away from their CS&T experience? Do they learn or become aware of new science and technology? Does CS&T satisfy their expectations? Are visitors satisfied with their CS&T experiences, particularly their experiences in the exhibition area and live events? How does CS&T compare to the rest of the Museum or other institutions? What about CS&T do visitors appreciate and attend to?
- Do visitors trust the information they receive in CS&T?
- Does CS&T get established in the Museum? Do visitors come across CS&T by accident or are they aware of CS&T and include its offerings in their visit planning?
- What do visitors think about current science, health science and the nature and process of science?

<u>Science partners and participating institutions</u>

- How did they become involved?
- What were their reasons for participating and what were their initial goals? Where personal goals achieved?
- What were benefits and trade-offs of participation:
- What suggestions can offer for improving such a partnership?
- Was the partnership worth it?

2. Methodology

I. Overall evaluation design

The overall evaluation design for the CS&T Health Science Education Partnership consisted of three parts, all of which were closely tied to an assessment of the Center itself:

- A front-end literature review on the public understanding of (current) science and technology and museum initiatives that address science literacy (2002).[5]
- Formative/remedial evaluation of live events, labels, touchcreens and exhibits with considerable input of CS&T staff (2003).[6]
- Summative evaluation of audience/visitors' responses (audience feedback from live events, CS&T exit interviews, museum exit interviews; unobtrusive observations of visitors) and partnering scientists' and institutions' perspective of the partnership itself (face-to-face and telephone interviews with participating scientists and representatives from partnering institutions).

CS&T and the Health Science Education Partnership were engaged in a range of ambitious activities, not all of which could be assessed. The summative evaluation was thus focusing on audience feedback to their experiences within the museum itself and on the perspective on the partnership by outside partners.

The evaluation study is based on post-only, face-to-face exit interviews of museum visitors and visitors to CS&T, written feedback from visitors who attended various types of presentations on the multimedia stage of CS&T, face-to-face and telephone interviews and a focus group with partnering scientists and institutions, and unobtrusive observations. All interviews were structured to collect both quantitative and qualitative data. Rating scales, forced choice questions, and open-ended questions were mixed and partly triangulated. Visitor feedback was based primarily on self-report items. Learning outcomes were assessed through self-report items.

Visitor behavior was studied using unobtrusive, structured observations ("tracking"). Respondents were tracked throughout their stay in the gallery, and their engagement and social interaction behavior was recorded at each exhibit.

The summative evaluation focused on determining the effectiveness of CS&T to engage its target audience in the exploration of current science and technology, primarily related, but not restricted to health and medical technology. The study was based on the notion of emerging findings since no overarching content goal could be defined other than providing visitors with an opportunity to explore cutting edge (medical) science and technology in more detail and with more accuracy than media would allow for, and to introduce visitors to the complex nature of science and the scientific process.

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[5] Storksdieck, M., Cohen-Jones, M., Falk, J. H., Alpert, C. L., Contini, H. (August 2002). *Museum of Science, Boston, Current Science & Technology Center: Public Understanding of Science. A Literature Review*. Annapolis, MD: Institute for Learning Innovation.

[6] Storksdieck, M., Alpert, C. L., Cohen-Jones, M., Tanguay, M. & Weiss, A. (January 2003). *Museum of Science, Boston, Current Science & Technology Center: Staff Presentations. Remedial Evaluation Report*. Annapolis, MD: Institute for Learning Innovation.
Storksdieck, M. (March 2003). *Museum of Science, Boston, Current Science & Technology Center: Guest Speaker Series: Remedial Evaluation*. Annapolis, MD: Institute for Learning Innovation.
Storksdieck, M. & Tanguay, M. (May 2003). *Museum of Science, Boston, Current Science & Technology Center: Current Science Theater/Forums. Formative Evaluation Report*. Annapolis, MD: Institute for Learning Innovation.

In summary, the evaluation design was based on a two-pronged approach: self-report data collected through questionnaires, interviews, and feedback forms, and behavioral data collected through direct observations (tracking).

All instruments used in this evaluation were developed in close cooperation between the Institute for Learning Innovation and CS&T staff and interns. Tracking data were collected primarily by CS&T interns who were trained by M. Storksdieck. Interviews with museum visitors were conducted by M. Storksdieck and three CS&T staff members during Aril and June 2004. Presentation feedback forms were collected by CS&T staff between April and September 2004. All interview data was transcribed into an Excel data sheet, and coded by Institute staff. Coded answers were transferred to the data analysis and statistics program SPSS for Windows Version 12 and analyzed using appropriate descriptive and inferential statistics.

All instruments can be found in the Appendices 1-6.

II. Specific methodologies

1. CS&T exit interviews

Exit interviews were conducted to receive immediate feedback on the experience of the CS&T area, and were the main method to assess the quality and effectiveness of CS&T exhibits and touchscreens overall, rather than specific components of the CS&T space. An interview protocol and questionnaire was developed jointly between Institute researchers and CS&T staff to ensure that individual questionnaire items were connected to project goals and that all project goals that could be assessed through an interview with visitors to the CS&T area were represented by valid items. The questionnaire was pilot-tested with visitors and edited for length and sequence of questions (see Appendix 1).

Exit interviews were conducted with a random sample of visitors who exited the space at pre-defined, though imaginary "borderlines." While many Museum visitors passed through the centrally-located CS&T space on their way to other attractions, sampling was restricted to visitors who spent at least a few minutes in the space or interacted with at last a few exhibits while passing though. Exit interviews were thus biased towards visitors who engaged in the CS&T space. While this method seems to bias the responses, it is important to note that regular museum exhibition exit interviews are conducted with visitors who enter, and subsequently exit, a defined and mostly self-contained area of the museum. This was not the case for CS&T. CS&T serves as a major crossroad between Museum areas, and visitors who pass though without significant interaction do not indicate disinterest, but a determination to reach their destination. That is, researchers had to define a degree of interaction and engagement in CS&T that merited the designation of a respondent as CS&T visitor, rather than passer-by. (A similar method was used by Institute researchers to assess the Global Links exhibition at the Smithsonian Museum of Natural History.)

[It is important to note that this evaluation did not focus on individual exhibits or its elements, like object cases or individual touchscreens, but on their combined effect on visitors. While it is possible to conduct summative evaluation on the scale of individual exhibits, this could not be done within the context of this research study, and would not significantly help answering the overarching research and evaluation questions].

2. MOS exit interviews

Museum exit interviews were similar to the CS&T exit interviews (see Appendix 2), and featured a range of overlapping questions. However, the Museum exit interviews were conducted for a different reason. The exiting visitors were used as a proxy for the overall population, and their perspectives on CS&T, current science and the nature of science and the scientific process was not only believed to represent the science museum visiting public, but the science-interested public at large. Random sampling was conducted at various locations outside the exhibition halls, but inside the museum building: the main entry hall of the museum, the food court, and the benches outside the gift shop. Since a range of questions on the Museum exit questionnaire related to CS&T, and since not all visitors had spent time at CS&T, the sub-sample of respondents who could answer specific questions about CS&T was far smaller than the sample itself.

3. Written feedback forms for presentations on the multimedia stage

A written feedback form was developed, based on a similar instrument that was used to assess live events in 2002 and 2003, though the focus was on summative questions (see Appendix 3). The written feedback form was kept to one page (letter size). The forms and golf pencils were placed on benches prior to the start of the event. The host of the event generally asked visitors to complete the surveys afterwards. The placement of this request varied from host to host and event to event, and response rates tended to be low (20% and less), since no direct encouragement was given. It is not possible to assess whether this sampling method created a systematic bias in favor of visitors who enjoyed the presentations, though the data need to be interpreted to indicate the positive and very negative spectrum of responses (self-selection bias).

4. Structured observation: timing and tracking in CS&T

Unobtrusive observations were conducted with visitors who entered the CS&T space. Their movement was marked on a map of the area, and their degree of engagement with exhibits and their social interactions, as well as the entry and exit time and observable demographics recorded by researchers (see Appendix 4 for the map and tracking guide). Tracked visitors remained anonymous for the researcher, and were not made aware of the procedure, thus minimizing the possibility of behavioral bias that has been raised for cued tracking.[7]

5. Interviews with partnering scientists and institutions

The interview format for individual scientist and representatives of partnering organizations was a focused, half-standardized, investigative, single interview with mostly open-ended questions. The interview was once conducted as a group interview with four scientists who had made presentations on the CS&T multimedia stage. All interviews with institutional representatives were conducted by phone; some of the scientist interviews, on the other hand, were conducted face-to-face. Interviews lasted between 10 and 20 minutes and discussed the reasons for participation, benefits and costs, an assessment whether and why the partnership was successful, whether personal goals and objectives were achieved, and suggestions for improving the partnership. The interviews can be found inn Appendix 5 and 6.

[7] Beverly Serrell, personal communication. Serrell collected data on the effect of cuing on visitor behavior in galleries and found that visitors who were informed (and agreed to) their observation spent as much as 50% longer in galleries than visitors who were not told that they would be observed.

3. Results and Discussion

The health-science partnership funded by the SEPA grant was embedded within a larger experiment, with far broader implications, namely how a science museum can bring a deeper understanding of current science in its outcomes and its process to a museum audience. The evaluation of the Health Science Education Partnership can therefore not be separated entirely from an assessment of CS&T as a model for current science communication within a brick and mortar museum overall.

This summative evaluation was conducted as four independent studies: (1) audience feedback to the exhibition area, (2) audience feedback to live events of various formats and kinds; (3) observation of CS&T visitors; and (4) an assessment of the partnership by participating scientists and by partnering organizations. The results and implications of these four studies are reported below.

Study 1: Audience/visitors to the exhibition area

Museum exit interviews were conducted with 67 individuals in 43 groups and CS&T exit interviews with 43 individuals in 33 groups. In all, 110 museum visitors in 76 visiting groups participated in exit interviews. However, sample sizes for various questions will vary, and generally be lower since not all visitors who took part in the survey were also answering all of the questions.

A range of questions were both asked of visitors who just exited the CS&T area and the museum. Data are partially pooled for both and reported jointly, or contrasted when appropriate.

1. Visitor background

1.1. Visitor demographics

About a fifth of the overall exit interview sample were members or regular visitors, 43% stated that they were occasional visitors (and many of those had not visited for years), and 37% were first time visitors to the museum. Sampling occurred during spring break (April 2004); almost half of the sample (48%) was either from outside the 495 Beltway surrounding Boston, or from a neighboring state, thus had to travel for more than 1.5 hours to visit Boston and the Museum of Science. About 36% were local or regional visitors (within Route 128), and 12% were out-of-state. Three interviewees (3.7%) were from foreign countries.

CS&T is designed for any visitors, but has particular appeal to those who seek new and updated material and who have a specific interest in current health science, nanotechnology, technology and material science, earth science and astronomy. CS&T is therefore more likely to appeal to repeat visitors. Repeat visitors to museums tend to be more purposeful in their visits than occasional or first-time visitors, and CS&T provides visitors with a destination that is less likely used by typical first-time or occasional visitors. First time or occasional visitors tend to browse through the museum in a visitation strategy that allows them to cover as much of the museum experience as possible.[8] They are therefore less likely to

[8] See Falk & Dierking (1992 and 2000) for a more comprehensive description of museum visitors and museum visitation strategies.

invest 15-20 minutes on a specific program element like the events on the CS&T multimedia stage or to explore specific health science information on a touchscreen.

⇒ 80% of the sample consisted of first-time or very infrequent museum visitors. It is therefore likely that this evaluation will underestimate CS&T's overall benefit to its target group.

The majority of interviewees (88%, n=75) were Caucasian, reflecting the visitorship to the Museum of Science in general; 5% were Asian Americans, 4% African-Americans, and 3% declared a different or mixed ethnic background.

Two-thirds of the visiting groups in the sample (n=54) were families with children; a quarter (n=25) were adults groups and couples, and 8% were individuals who had visited on their own; all of those were interviewed when leaving CS&T. More than the rest of the museum, CS&T attracted individual visitors, and family visitors with older children: the average age of the youngest child in the 20 family groups of CS&T interviewees was 11, compared to 7 for those 29 who were interviewed when exiting the museum ($df=1$, $F=15.3$, $p<0.0001$).

⇒ Within the limitations of overall science museum visitorship, CS&T succeeded in attracting its target audience.

Ninety respondents revealed their age. 56% of the sample was between the ages of 35 and 54, 18% were between 25 and 34, 12% were 55 or older, 4% were 18 to 24, and 9% were 12 to 17.

The majority (55%, n=49) of interviewees were female, though there was a difference between the two samples: less than half (47%) of the CS&T exit interviews, but almost two-thirds (63%) of the museum exit interviews were conducted with women.

1.2. Reasons for visiting

Approximately a quarter of the sample visited the museum primarily to satisfy their own curiosity and interest, and another quarter to satisfy the needs of others who accompanied them to the museum. Half of the sample indicated that they were present in part because of others in their group, but also to satisfy their own interest. Most who stated that they visited at least in part for others said that the visit was to benefit their accompanying children.

⇒ A large majority of visitors pursue their own agenda during a visit to the Museum of Science. However, many bring children and may be confined in their exploration and attention by the needs of their accompanying children (which did not form a target audience for this project).

1.3. Previous knowledge of CS&T

About a fifth (19%, n=14) of respondents had heard about CS&T prior to their visit to the museum, a rate that was slightly higher for CS&T interviewees than museum exit interviewees (24% vs. 16%). When asked where they had first heard about CS&T, 71% stated that they learned by simply walking passed by it during their exploration of the museum. Less than 7% knew about the center prior to their visit.

⇒ CS&T still needs time to brand itself. Many visitors are not aware of it and do not strategically plan their visit to CS&T, thus potentially missing what could arguably be seen as CS&T's major attractions: live events that take place on the multimedia stage.

1.4. Watching NECN and visiting the website

Twenty-nine of 66 (44%) respondents stated that they watched New England Cable News (NECN), most of them occasionally. Only two of the 29 had seen a CS&T-related program on NECN, and both said it didn't influence their decision to visit.

Forty-three of 84 respondents (41%) had visited the museum's website prior to coming to the museum. Most did so to look up ticket prices and schedules, learn about special programming, buy tickets for the planetarium and Omnimax theatre, and to preview exhibits. Only three of 68 respondents (4%) had also visited the CS&T website, primarily as they browsed the museum website.

2. Visitor appreciation of CS&T

2.1. Recognizing CS&T when there

The CS&T exit interviews were started with the question whether respondents knew which area of the museum they had just exited. Nine of 34 respondents (26%) knew that this area was CS&T, six (18%) looked around and saw the logo or gave the answer only after prompting, and 19 (56%) did not know that the area they just exited was CS&T. Despite the newsband, banners, and the projection of the CS&T logo on the floor (and a large CS&T logo on the back wall), many visitors could not identify CS&T as a distinct area. This does not surprise and could be considered the price CS&T had to pay in order to be positioned in the heart of the museum, as an open, inviting forum.

A third of the CS&T exit interviewees (11 of 33) had been in CS&T before, either earlier that day or during a previous visit to the museum. However, two-thirds had not. Three out of 26 CS&T respondents (11.5%) had intended to visit the center before they actually visited CS&T. CS&T is not yet part of the reason for why museum visitors arrive at the Museum of Science.

Fourteen of 19 CS&T respondents (74%) believed that CS&T was different from the rest of the museum. Most respondents referred to the physical set-up and the presentation styles when answering the question; fewer referred to the content:

- Open space, multiple access allows more people simultaneously, easy to leave (8)
- Provides touchscreen technology (4)
- More current/contemporary (3)
- Provides seating (3)
- More technology-based than rest of the museum
- Less interactive, with more to read (and learn)
- More relevant to daily life
- Focus on medical issues
- Presentations are like street performers (open, can leave any moment)

The following quote illustrates a comprehensive answer to the question whether CS&T is different from the museum that included an implied praise:

> *It seems like a different part from the rest of the museum, with a stage, newsband, light shows, seems like the center of attention. I've already been here in CS&T multiple times today.*

However, there was also criticism voiced:

It's annoying to walk around during presentations because of the noise; conversely, when listening to a presentation the surrounding noise becomes distracting. I saw other presentations here before, and I would suggest that they have them elsewhere.

2.2. Rating CS&T

Visitors were asked to rate their experience in CS&T in two ways: relative to other areas of the museum, and in absolute terms. The relative rating was conducted across four dimensions: whether CS&T was overall better, more interesting, more for adults and more current than the rest of the museum. Interviewers used a semantic differential (better/worse; more/less interesting; better for adults, better for children; more/less current) and a six-point scale from 1 to 6, with a theoretical mid-point of 3.5. Forty visitors altogether took part in the comparative rating. [Many MOS exit interviewees had not spent enough time in CS&T to feel comfortable rendering comparative ratings, and many of the CS&T visitors who were interviewed had not yet visited the rest of the museum.]

The majority of visitors (26 out of 40, or 65%) perceived CS&T as "better" than the rest of the museum. Eleven (or 28%) defied the rating scale that did not offer a midpoint and declared CS&T as "like the rest of the museum" (often indicating that they liked the museum), and just 3 visitors (8%) rated it worse than the rest of the museum (see Table 1).

Table 1: Visitor rating of CS&T

		Rating scale in comparison with the rest of the museum				
		Better/worse (n=40)	Interesting/boring (n=42)	Geared towards adults/children (n=50)	Current/established (textbook) (n=47)	Absolute overall rating (n=53)
Rating score	6	12.5%	26.2%	16.0%	40.4%	11.3%
	5	25.0%	26.2%	44.0%	29.8%	49.1%
	4	27.5%	23.8%	26.0%	14.9%	30.2%
	3.5	27.5%	14.3%	6.0%	2.1%	1.9%
	3	5.0%	9.5%	2.0%	10.6%	5.7%
	2			4.0%		1.9%
	1	2.5%		2.0%	2.1%	
	Average	4.2	4.6	4.6	4.9	4.6

Thirty-two out of 42 (76%) visitors considered CS&T more interesting than the rest of the museum, 14% stated that it was equally interesting, and four (10%) found it slightly less interesting (all of whom were MOS exit interviewees).

Visitors had a strong sense that CS&T was serving adult audiences; 43 of 50 visitors (86%) rated the center as "more adult," three visitors (6%) felt that it was similar to the rest of the museum in that regard and four visitors (8%) felt that it was more appropriate for younger audiences.

Most visitors (40 out of 47, or 85%) perceived CS&T as more current than the rest of the museum, and 40% even chose the extreme end of the scale. There was a significant difference between MOS and CS&T exit interviews: 63% of those interviewed when exiting CS&T considered the center far more current (6 on the scale), compared to 17% of those interviewed when exiting MOS (Mann-Whitney U-test: $Z=2.86$, $p=0.004$). CS&T interviewees gave the center a score of 5.4 on "current", compared to a score of 4.5 given by MOS interviewees.

⇒ Visitors to CS&T clearly identify CS&T as a place where they can get current science and also see it as place for adult visitors.

Finally, visitors were asked to rate CS&T in absolute terms between 1 and 6, and were told to think of the rating as a star rating for movies. Thirty-two of 53 visitors (60%) rated CS&T with a 5 or 6, a quarter (n=14) rated it with 4 (and therefore above average), and only 5 visitors (9.5%) rated the center at average or below. The overall ratings of 4.6 compares well to the 4.7 score on a similar scale for a traveling exhibition on dogs at the Natural History Museum of LA County[9] and the Air & Space Gallery of the California Science Center[10] (see Table 2). The absolute rating of 4.6 indicates that the gallery provided for a satisfactory, though not necessarily awe-inspiring experience.

Table 2: Comparison rating of three exhibitions

	Overall Rating		
	MOS CS&T (n=53)	CSC Air & Space Gallery (n=97)	NHM Dogs traveling exhibition (n=148)
1	0	0	0
2	2%	2%	1%
3	8%	8%	7%
4	30%	25%	33%
5	49%	33%	40%
6	11%	29%	20%
Average	4.6	4.7	4.7

⇒ The ratings indicate that CS&T was perceived by visitors as a section of the museum that features current science for adult audiences. The absolute rating of 4.6 on a 6-point scale is surprisingly high, since the exhibition space is somewhat ill-defined for visitors and featured relatively few exhibits.

2.3. Reasons for ratings

Few visitors commented on the reasons for their ratings. Only seventeen visitors, for instance, commented when asked to explain the rating on whether CS&T was more geared towards adults than the rest of the museum. Fourteen answers focused on children, and ten of those stated that the area lacked hands-on interactives and was too difficult for children. The following quotes illustrate these opinions:

Many adults have young kids under 10; we need to choose areas that are good for children.

Kids don't grasp high tech.

More reading, not as much hands-on.

Probably better for adults, my 8-year old needs more hands-on.

Some visitors, however, disagreed with this assessment; they saw opportunities for children to interact in the exhibition area of CS&T:

[9] Storksdieck, M., Foutz, S, Kessler, C. & Kisiel, J. (August 2003). Natural History of Los Angeles County, Dogs, Wolf, Myth, Hero & Friend: Summative Evaluation. Annapolis, MD: Institute for Learning Innovation.

[10] Storksdieck, M., Foutz, S, Kessler, C. & Burtnyk, K (March 2004). California Science Center, Air & Space Gallery: Summative Evaluation. Annapolis, MD: Institute for Learning Innovation.

The interactives are more for children, and the information for adults.

The kids get to experience touchscreens.

And two visitors reinforced the notion that in their stage presentations CS&T staff was able to target the information and comprehension level well to their definition of "adult audiences", i.e. visitors 12 years of age and older:

[CS&T is] for 10 and up, very clear, not at [a] high level, we are not scientists.

The kids liked it [children were 12 and 14].

Most visitors who rated CS&T as more current than the rest of the museum did not elaborate why. However, some who did not consider CS&T as more current than the museum as a whole pointed to a specific water filtration exhibit that featured an inexpensive low-tech ceramic-based and cheap water filter system that MIT engineers had developed to be compatible and affordable for residents in certain under-developed countries and contrasted that with a modern consumer water filter on performance, availability and price. Some visitors did not understand that the current science and technology featured in this particular exhibit element was "low" rather than "high" tech:

Water filters exist (sic) for a long time.

The ultrasound was current, but the water filtration was not.

The few who mentioned why CS&T was more current tended to focus on health information:

The health information is current (stem cell, diabetes).

I work in a small hospital and don't see that much of new technologies.

Twenty-nine respondents elaborated on their overall rating for CS&T. Positive ratings were connected with expressions that the exhibition area was interesting or fascinating in general; that it afforded learning; and that the information was new, unusual and up-to-date. Two visitors singled out the water filtration system ("water filter was fascinating, inventive, doesn't have to be fancy"). Negative comments related to the perception of CS&T as not much different from the rest of the museum, that it lacked hands-on exhibits for children, that it required a lot of reading, and that it wasn't cutting edge enough (again, a comment related to the water filtration).

⇒ The rating explanations reinforce the notion that the exhibition space was not outstanding in comparison to the rest of the museum. Given the location of the exhibition area and the open space design of CS&T in the heart of the Blue Wing, near elevators and on a major crossroad between various well-defined exhibition spaces, the ratings are positive and encouraging.

2.4. What did people like the best?

CS&T exit interviewees were asked to list those experiences which they liked the best. Twenty-six visitors answered the question. Six visitors who had experienced a presentation stated that they liked them the best. Five visitors pointed to the touchscreens as the best and two of them remarked that they enjoyed the interactive nature of the touchscreen experience. Health-related exhibits were often singled out: The

surgical tools (minimally invasive surgery) which visitors were familiar with but had never seen or experienced was mentioned by four visitors ("surgery tools: good knowledge to actually see tools and to experience them hands-on;" "the endoscopic surgical equipment drew our attention, I knew about it, but never saw it before"). The swallowable capsule camera was mentioned by three visitors ("capsule camera, interesting to see its size and function"), the artificial heart and the water filtration system by two, and the portable ultrasound by one visitor. The following quote exemplifies the experience that CS&T afforded an interested visitor:

> *I liked the work of the MIT student on water filtration: this opens kids' minds, is better than school; I didn't like the touchscreens, though my wife found information on nanotechnology there. One of our kids is interested in nanotech. The artificial heart: I liked the problem-solving approach. In general, these exhibits give broad sense how science is trying to fix problems.*

Other aspects of CS&T that were mentioned as "the best" during CS&T exit interviews were the displays/cases in general (two visitors), the case that featured electronic ink (two visitors), learning about space ships and the space program (two visitors), learning about new things – carbon nanotubes in particular (three visitors) and the fact that the CS&T exhibition covered a wide range of different topics (one visitor).

2.5. Did visitors trust the information they received?

Respondents were asked to rate the reliability and fairness of information in CS&T on a scale from 1 to 6, with 6 indicating the highest level of reliability and fairness. Twenty-nine visitors answered the question about reliability and 79% rated CS&T at a "6." All other respondents rated CS&T at "5.5" or "5." Seventy-seven percent of 26 respondents rated the fairness of information at a "6", 15% at a "5", and 8% at a "4."

⇒ Visitors to CS&T trust the information they receive in CS&T.

3. Visitor interest in current science and technology and the process of science

3.1. Interest in current science and technology

A little over a third (36%, n=22) of respondents follow science and technology intensively in the news, and a slightly higher percentage (42%, n=25) follow health science in the news "a lot."

Overall interest in current science and technology among visitors to the Museum of Science was expectedly high, though visitors who were asked when exiting CS&T were almost twice as likely to state a "high" interest in current science and technology than those who were asked when exiting the museum (see Table 3). General interest in science and technology was even higher, and again, visitors who were interviewed when exiting CS&T expressed a significantly higher interest than those who were interviewed when exiting the museum (Table 3).

⇒ CS&T seems to attract a subset of museum visitors who have a particularly high interest in (current) science. Alternative, visiting CS&T might raise visitors' awareness of (current) science in comparison to the rest of the museum.

Table 3: Interest in (current) science

		Exit interview conducted		Total
		CS&T (n=26/28)	MOS (n=39)	
Interest in current science and technology*	high	65.4%	33.3%	46.2%
	moderate	34.6%	59.0%	49.2%
	not or little		7.7%	4.6%
Interest in science/tech in general	high	71.4%	46.2%	56.7%
	moderate	25.0%	48.7%	38.8%
	not or little	3.6%	5.1%	4.5%

*Chi-Square = 7.3, df=2, p=.025

In a recent front-end study on museum visitors' perspective on current science, respondents were asked to rate on a scale from 1 to 10 their interest in seeing examples of science that is recent or in the news during their visit.[11] Answers were highly skewed and researchers interpreted the scale by assuming a high degree of bias. Still, the answers indicate that about half of the visitors are highly interested in seeing current science in a museum (rating of 9 or 10); a little more than a third are moderately interested (rating of 7 and 8) and about a tenth were little or not interested. While the scales used in this study do not necessarily represent the same meaning to respondents, the data still indicate that CS&T visitors might show a particularly high interest in current science and science in general.

3.2. What do visitors perceive as current science?

Seventy-two visitors shared their perspective of what makes science "current" for them and while their perspectives were divergent, half perceived "current" to entail cutting edge science and up-to-date information on science in progress (see Table 4). Some respondents provided a time frame when discussing "current science" and there was little agreement between visitors. While many saw "current" as synonymous with "now" or even "upcoming," or "breaking news" and "new discoveries," others felt that anytime between 3 and 15 years past would still qualify as "current."

Some visitors focused on applied areas of science and technology instead of process or time frames and identified biotechnology, genetic engineering, medical science and technology (for instance stem cell research), space science ("Mars is current"), or technological advances that have relevance to our lives (for instance cell phones) as areas that merit the qualifier "current". One visitor interpreted the question to mean what type of presentation style in a museum should be considered "current" and referenced the big media screen of CS&T and the updateable computer touchscreens as current.

Some visitors who described their notions of "current" also shared spontaneously their sense of the museum or CS&T as venues that presented current science. Visitors generally believed that CS&T featured current science, though not all exhibits were identified as such, and the museum overall was seen as less current and more textbook. However, not all visitors objected to a presentation of established science in a science museum, as the following quote illustrates:

> *[Current is] development in the last 5 years. I like things in a museum to be reasonably up-to-date (last 10 years or so), though it's good to have older theories that are established explained.*

[11] Hayward, J. & Hart, J. (October 2004). "Front-end" Research for Current Science Exhibits at the Science Museum of Minnesota. Northampton, MA: People, Places & Design Research (http://www.informalscience.org/tools/reports/105.html)

Table 4: Visitors perception of "current science"

Category	Frequency (n=72)	Examples
Now, cutting edge, up-to-date	**50.0%**	"something that happens right now," "breaking news," "breakthroughs," "learning about a new way of doing things, like less invasive surgery," "just getting to be exploited, new in current technology, in contrast to steam powered engine," "latest advancements in technology that are in use," "most recently available," "new discoveries from the past week," "new, innovative, 'you would come to a place called Current Science and Technology expecting to see something or learn something brand new that you haven't seen before'," "new, recent; probe was launched yesterday; a few months old," "newest stuff. Things not widely in use now or just start to be. Things people should know about. 3 years ago: hybrid car would have been cutting edge."
• Research or development that occurs now or is ongoing:	9.7%	
• Up-to-date	6.9%	"up-to-date, new, even in the process, beginning stages of something"
• "Cutting edge"	5.6%	
• Breaking news	2.8%	
Topics	**20.8%**	
• Health/medical science & technology	12.5%	health research, stem cells, Brita water filter, new medical technology, medical updates and breakthroughs, biotech, portable ultrasound
• Space science	9.7%	Mars (rover, exploration - mentioned four times), NASA, space shuttle
• Computer technology	2.8%	
• Science in the news	2.8%	
• Other topics	5.6%	environment, new and proven theories, impact of current technology, new technologies
Time given	**12.6%**	
Within a year	2.8%	
Within three years	1.4%	development in the last 3-5 years; stuff in recent journal articles; yes, they saw e-ink recently in magazine and now here.
Within 5 years	5.6%	maybe research and development phase, last 5 years
Within 10-15 years	2.8%	
New technologies that impact everyday life	**9.7%**	"Things that make our lives convenient like a better cell phone;" "something about cell phones, something in our immediate world and the science around it."
Future developments	**4.2%**	Things that the visitor wouldn't know, I would like to see things that are current and futuristic
Presentation style	**1.4%**	big screen. Updateable computer [current refers to content and presentation style]
Other	**2.8%**	The applications of science; age doesn't matter when it comes to "current", see Einstein and how current his ideas still are; current is tied to learning in school.
Criticism	**4.2%**	The name of the center is weak, it needs something more catchy, "current" is weak, "leading edge" would be better; it should feature a mix between the familiar and the unfamiliar; some stuff here is becoming standard procedure.

3.3. Current science at MOS or CS&T?

More than half (54%, n=28) of respondents considered the museum as very current. They felt that the museum provided them "a lot" with current information on science, technology or health-related issues. Another 29% (n=15) felt that the museum was at least somewhat current. Almost three-quarter of respondents (73%, n=44) stated that it was very important to them that the museum be current in its offerings, and a quarter (n=15) stated that it was "somewhat important" that the museum do so. Only a small group of those who felt that the museum needed to be current actually perceived the museum as not current (13%, n=5).

Recent front-end research at four science centers across the country (Science Museum of Minnesota, Maryland Science Center (Baltimore), Oregon Museum of Science and Industry (Portland), and the Science Center of Iowa (Des Moines) revealed that "at science museums, most visitors do not think they

are seeing information that is current or recent."[12] Interviews conducted in 14 locations across the four museums revealed that a majority of visitors referred to the information they saw as 'well established' science. Only visitors to the Maryland Science Center's Space and Body Link galleries perceived a degree of current in the exhibition: A third of them stated that the science presented there was 'recent science.' The report authors speculated that visitors to science museum permanent exhibitions may expect information to be well-established rather than current or recent, though many visitors to the Museum of Science in Boston expressed a stronger demand for current science at the museum.

⇒ Visitors to the Museum of Science, Boston, may differ from visitors to science museums and science centers in other parts of the country in their degree of their expressed demand for current science at a museum.

3.4. Interest in the process of science

Forty-three of 63 respondents (68%) stated that they were interested to learn about the process or nature of science in general, seven (11%) said that their interest depended on how it was presented, and 13 (21%) were not interested and mostly added that they were just interested in the results and outcomes of science. While the majority of those who were interested in the process of science also expected the museum to portray science as a process or to illustrate how science is conducted, many also voiced concern that the scientific process was difficult to portray or simply boring for visitors. Some did not expect the museum to truly describe the scientific process. Interviewers did not specifically ask whether respondents were expecting a science museum to feature "the process of science", though 21 respondents remarked on their expectations. Thirteen (62%) stated that they expected the museum to describe the process of science and eight (38%) explicitly did not, primarily because they believed the setting unsuitable. Fourteen respondents remarked on whether they actually found descriptions and explanations for the process of science in the museum; ten of those (71%) did find them in the museum, four did not. A museum exit interviewee remarked "[I'm] very [interested] and expect the museum to present [the process of science], but I don't find it here, [though] I would like to see it." This statement can be contrasted to one given by a visitor who was interviewed while exiting CS&T: "[the process of science is] most important [to me]. CS&T does provide a research perspective, [I] came back to the CS&T section because of its currentness; it is on the cutting edge. I was looking for something like this in the museum."

⇒ Many visitors to the museum show an interest in the process of science, though there is no consensus whether the museum is an ideal place to present the process of science. Visitors to CS&T were more likely to have encountered and perceived aspects of "process" or how research is conducted than visitors who did not visit CS&T.

The following are examples of answers given by respondents to the question whether they are interested in the process or nature of science:[13]

Yes, interested in the process of science and found it in the museum

- "Yes, I'm fascinated about how they figure stuff out."
- "Yes … I want to know how they get the answer; that's why the presentation was good."

[12] Hayward, J. & Hart, J. (October 2004). "Front-end" Research for Current Science Exhibits at the Science Museum of Minnesota. Northampton, MA: People, Places & Design Research (http://www.informalscience.org/tools/reports/105.html)

[13] Readers should be aware that the exact wording of the question was of particular relevance for this question. The terms "process of science" or "nature of science" can both easily be misunderstood by visitors. In this particular study, data collectors expanded on the terms and provided visitors with a deeper understanding of the terms.

- "Yes, to some degree, for a lay person, not too technical, and I found it inside."

Yes, interested in the process of science but did not find it in the museum

- "Yes; I don't want to take science at face value; the museum should cover that; does the museum not do that? Would be good if they did. Connect to the scientific process, for instance have 3rd graders write lab reports."

Yes, if presented right

- "To a certain extent; here: only if it's unusual, if there's a human interest aspect, something unique you can relate to. Conveying the research process is okay; but it needs to be simple enough for children."
- "Yes, if it is put in larger terms. I am not a science fanatic."
- "Yes. The museum should do it, but how in depth is questionable."

Not interested, but exhibit process of science in the museum

- "[I am] interested in final product, the end result; I'd expect museum to show me how they get there and they do."
- "I do like to see the statistics; it depends; though I don't really care how they got there. I'd expect the museum to show me how they get there and they do."
- "I expect museum to do that, but if research is conducted by a big company, it might not be objective."
- "Mostly just results, but sometimes they depend on the process."
- "Would be boring for kids and me too. Both, how and what should be presented in museum."
- "Would be nice if they [the museum] had something on it. Might be to dry, though, but would be good if they touched on it."
- "Yes, the way research is done has impact on the outcome, also influences who supports it. I don't expect this in museum. For example stem cell research: It's an important topic and people need to know about it; the museum shouldn't shy away from it."

Not here at museum

- "I do research. It might be cumbersome, might be an option, but setting doesn't lent itself for that."
- "I want to know; exhibits are more for children, if you want to know about research you'll find that in a library or university. A science museum is not the right venue for this."
- "[I have an] interest in how science is done, how they make things better; research on cancer: what do they do, what tests? I don't expect the museum to provide me with this type of information."
- "The museum setting is not ideal for that."
- "That might be challenging since research is done in many ways."
- "More results than process, cause lots of politics is involved in the process of science. The Museum should show theories in an unbiased fashion."

Not interested in the process of science

- "I am more interested in the application of it, not the research."
- "I just want to know the outcome, don't need to know the steps."
- "That's a snoozer, just give me the results."
- "I expect more the results of science."
- "Just results, no process."

[It should be noted that CS&T provided visitors with a variety of programming and exhibits that featured the process of science.]

3.5. What areas of science are of general interest to visitors and why?

When asked what areas of science they were interested in, almost a quarter mentioned health and medical science, and another 17% life science, biology and genetics. However, interest in science amongst visitors was spread across a wide range of topics (see Table 5) that included space and physical science and the environment. About a third of visitors expressed a general interest in new science, technology and engineering or less specifically, overall science.

Table 5: Areas of science interest

Area of science	Percent (n=69)
Medical science and technology/health	23.2%
Life science/biology/genetics	17.4%
Space-related topics	15.9%
(New) science and technology/engineering in general	15.9%
General interest	15.9%
Physical/earth sciences	13.0%
Environment	7.2%
Nanotechnology	4.3%
Consumer tech/computers	4.3%
Science and society	4.3%
Math	4.3%
Not (particularly) interest in science	4.3%

Note: Percentage add up to >100% due to multiple answers.

The most frequent reason for their interest in science given by respondents for their particular interest in science was professional (42%): these respondents worked as scientists and engineers, taught or attended university. Some worked in the medical field as nurses or researchers (see Table 6). Almost thirty percent of respondents mentioned that their particular interest in science stemmed from their perception that science played an important role in society, and a quarter expressed general interest.

Table 6: Reasons for science interest

Reason given	Percent (n=41)
Professional interest (teaching, work in science or engineering, university student)	41.5%
Affects life (impact of science and technology, environment) or helps us solve problems	29.3%
General interest	24.4%
Other's interest (friend, husband, child)	7.3%
School or university education, prior experience	7.3%
Curiosity/interest in learning	7.3%

Note: Percentage add up to >100% due to multiple answers.

4. Impact on CS&T visitors

Impact of a visit to CS&T was measured in three ways: (1) Qualitatively by assessing what visitors took away from their experience, and quantitatively by assessing (2) whether CS&T provided visitors a better sense on how research is conducted, and (3) whether they reported that they would be more likely to pay more attention in the future to science stories they first heard about in CS&T.

4.1. Visitor learning in CS&T

Visitor learning in CS&T was difficult to assess, since there was no overarching theme or cohesive message that was conveyed. Visitors were encouraged to follow their interest in a range of subject matters, foraging for information as needed or as it fit their interest, utilizing touchscreens, exhibit cases with labels, and a few interactives. Some visitors attended a presentation, though presentations are discussed elsewhere in this report. Researchers thus decided against testing for cognitive gain, and instead used a qualitative approach to assess how and in what areas visitors believed to have learned by asking them to simply elaborate briefly on one thing they learned from their visit in CS&T.

In order to appreciate the statements that follow, it should be noted that visitors spent between a few minutes in CS&T, looking at just one or two cases while passing through the exhibit space to almost an hour reading all the materials on diabetes and other health-related issues on the touchscreens.

In general, almost all visitors felt that they learned something interesting in CS&T, and much of the information was health-related. Those who stated that they did not learn anything (new), about 4 out of 28, believed that this was due in part to their short stay in the area; some were simply professionals who were already familiar with the subject they focused on and thus did not perceive CS&T to provide them with new information.

Specifically, many visitors mentioned an exhibit on water filtration that contrasted a modern Brita home water filter with a cheap ceramic-based alternative for rural areas in developing countries. The project was part of an MIT based public health initiative:

> *I learned about microbes in the water [water filtration].*
>
> *I have a Brita water filter, and I learned new stuff I didn't know about, like the MIT research on water filtration.*
>
> *The water filtering systems contradicts the idea of high and low tech.*
>
> *I learned about water filtration and the artificial heart.*

As the last example illustrates other visitors were fascinated by new medical technology like the artificial heart, the portable ultrasound unit, or minimally invasive surgery:

> *I learned a lot about the AbiCor heart, they showed the shortcomings of the heart.*
>
> *If I needed the AbiCor [artificial] heart, I couldn't get it. I'm too small.*
>
> *I never heard of a portable ultrasound that size.*
>
> *The portable ultrasound: just the size of it; to know that there is something out there that small.*

[I learned about the] existence of some new devices, not just pictures in a book. I saw authentic images from the portable ultrasound.

[I learned] about surgery tools […]. I saw something like the tools on TV, but CS&T] gave me more information than the TV story.

Furthermore those who listed one of these technologies often mentioned another one as well, indicating an overall interest in new medical technology and a design of the exhibit area that allowed and encouraged a clustered perspective:

[…] seeing the Sonosite [portable ultrasound] and AbiCor Heart [implantable artificial heart].

Visitors listed a range of other health-related facts they learned or learned about while in CS&T:

I scanned health issues on the touchscreen: stem cell research, diabetes; all that was current but not new to me.

I learned about the different types of fats.

Outside of health, CS&T visitors learned about an eclectic array of topics, from the search for a new superglue by studying geckoes to basic physics and biology; from the workings of the space shuttle and superconductors to the use of remote technology to uncover the secrets of Egyptian pyramids:

They are experimenting on geckos to determine what it is in their hands and feet that allows them to adhere to shiny surfaces. They are looking for new adhesives. Maybe that leads to a Spiderman toy: they can then use newer technology. My son is interested in geckos.

A bike wheel that spins doesn't flip over; a bigger person is needed for heat [refers to surface-volume problem]; all of these things taught me something.

I learned about rockets on the shuttle and how they work. I learned how to read an ultrasound, I didn't know before what these pictures meant.

I learned about magnetic and temperature effects on superconductors.

I've seen information on TV, but there was more here about drilling in-depth in the pyramids [refers to robotic Rover in pyramid story].

The touchscreens introduce topics I wouldn't have known about. On TV they don't explain it, they give details here; I learned a lot.

The last two quotes indicate that one underlying premise for CS&T was true for some visitors, namely that visitors come with an awareness of certain science or technology stories from media coverage and are now ready to explore the topic in more depth.

Other visitors expressed a more refined understanding of science and technology as an endeavor that helps solve problems and is not necessarily linked to expensive technology:

Science and technology is solving problems not just by involving a lot of money; some is not expensive and very accessible [MIT research on low-cost water filtration].

One visitor's quote illustrates that CS&T is beginning to distinguish itself as a location within the museum that features current science and technology:

I learned about new technology; they use this place to present current science.

The following quote by a local man in his late 20s who had visited about a year earlier with his mother when they attended a presentation about cancer at the CS&T stage illustrates some of the affordances as well as challenges of CS&T:

There is always something you can learn in this place; I like nanotechnology; if people knew that in the Blue Wing you can learn about the latest technology like nanotech or the Big Dig [different area of the Blue Wing that explains this major public works project in Boston], all the latest stuff, that you can get your science news here, even when you are local you get your science news here. Advertise it at the front desk, they do billboards for IMAX but not for CS&T, go advertise it on RT 128 or in Cambridge, advertise with people who are interested in current science [universities]. The challenge is to find a good topic. When I was here with my mom, she knew about cancer, but I didn't and [I] learned during that presentation.

⇒ The visitor clearly sees great benefit in having CS&T and other areas that feature current science in the museum, but feels that the museum is not doing enough to advertise this within relevant communities.

Those exit interviewees who had attended a presentation on the multimedia stage were also asked to summarize key points they took away from the presentation. Again, the few answers (n=11) do not allow for drawing broader conclusions but are merely indicative for the kind of information that visitors received and the type of learning that presentation can afford:

One person simply stated that they learned a lot from the presentation but did not elaborate while another one believed to not have learned anything. Three visitors learned about miniaturization in medical technology ("how small the tools are getting, small camera systems, portable ultrasound, minimally invasive surgery") and one stated that the presentation would have been motivating for medical students since it featured how innovation in medical technology helps save lives. One visitor stressed that the presentation was about bacteria in water and water purification, but felt that the presentation was not detailed enough. A visitor who attended Gravity Rules, a show that was staged in conjunction with the Einstein traveling exhibition, clearly identified the core story line behind the presentation:

Einstein was wrong once; we are still trying to prove Einstein; lots of his theories were correct, though and Einstein was more often right than other scientists.

Another visitor's remark spoke more to the need to feature current science on a museum setting than to the learning a presentation might have afforded:

I've been looking the entire trip for something on cutting edge research, particularly medical research [and found it here].

⇒ CS&T exhibitions and presentations serve as a powerful tool to raise awareness about issues in the majority of visitors. Many visitors "sample" the offerings selectively and retain snippets of

detailed and in-depth information, but remain on the surface in most areas, and thus remain on the awareness level of learning. This is by no means unusual and no way different from general learning from and in museums. Like other museum offerings, CS&T provides its visitors with ample opportunities to deepen their understanding about specific topics, and visitors who bring that level of interest to CS&T could often explore their interest in great detail. However, it should be noted that the majority of visitors to CS&T, the Museum of Science or any museum, "forage" and scan the museum, and only occasionally dig deeper to satisfy a particular interest.

4.2. Did CS&T provide a better sense of how research is conducted?

CS&T provided half of the respondents with a better sense on how research is conducted (see Table 7) and another 12% felt that it partially did so. [Note: this ought to be considered a high percentage, given the difficulty of presenting the process of science in a museum setting.]

Table 7: CS&T's capacity to cover the process of science

Did CS&T provide you with a better sense of how research is conducted? (n=32)		Example
Yes	50%	• Heart: you learned what rigorous testing is required, before it can be tested in humans. And it has to be a terminally ill person • It's surprising to see to what length scientists would go to get information.
Partially	12%	• A little I guess, you went thought the process of how things are done (gravity probe) • No, I don't think so, but for carbon nanotubes it's explained • The types of things shown give you an idea of research
No	38%	• Not process, but outcome and solutions • Was more the end product, not process • Not any of the ones I saw. Showed you outcomes, didn't go into more detail, its outcomes not so much how research is done • Outcomes, results, I think that the results are more important and the outcomes matter more

4.3. Paying attention in the future

Only 21 respondents answered the question whether or not they would pay attention to future news about something they heard in CS&T. Fifteen or 71% said that it was "very likely" that they would, and two felt that it was "likely." Three respondents chose "somewhat likely" and only one chose "not likely".

⇒ For those visitors who answered the question, CS&T clearly succeeded in creating interest and triggering intention to engage in follow-up activities or to seek subsequent reinforcing experiences. This is a significant result since free-choice learning experiences ought to be seen as part of ongoing, lifelong learning. Any educational activity, be it free-choice or classroom based that increases or even simply sustains interest, attentiveness and engagement strengthens a person's capacity to learn.

Study 2: Visitor responses to presentations

1. Summative results from previous, remedial research

Previous formative and remedial research on various live event types, while not conducted to assess outcome, still indicated that CS&T was highly successful in staging events on its multimedia stage that were engaging, enjoyable and educational, and it was recommended that CS&T offer as many of these live events as possible. Live events on the multimedia stage were generally well attended by museum visitors, despite the fact that most visitors learned about the events right before the start or upon entering the museum. Stage events lasted between 15 and 25 minutes and despite their considerable length were able to hold their audiences; few left during and mostly for timing reasons or because a young child lost interest. This "holding" power of live events is all the more astounding giving that events were targeted towards audiences 12 and up, but families with far younger children often attended.

The following provides a brief summary of results from three previous studies that were related to outcomes:

Staff presentations (n=59)[14]

- The majority of respondents described the specific science content of the show.
- A quarter focused on the aspect of "cutting edge" and future application in technology.
- 14% stressed the aspect of current science.
- Overall, respondents seemed to have had a good understanding of the overall nature of the presentations.

Guest speaker series (n=183)[15]

Most interesting concept learned?

Astrobiology Series:

- More than half the visitors learned some content-related facts and concepts,
- almost two-fifth learned research related concepts.

Medical Science Series:

- Three-fourth of respondents wrote down content-related facts or concepts,
- 21% research-related ones.

Science Theater (n=303)[16]

- 6 visitors (2%) stated that they had come specifically for the shows.
- Audience liked the quality, the speakers, and the learning potential
- Impact on visitors *(most interesting concept learned):*
  - 30% mentioned a specific technical term that was a core concept behind the presentation ("marker term").

[14] Storksdieck, M., Alpert, C. L., Cohen-Jones, M., Tanguay, M. & Weiss, A. (January 2003). *Museum of Science, Boston, Current Science & Technology Center: Staff Presentations. Remedial Evaluation Report*. Annapolis, MD: Institute for Learning Innovation.

[15] Storksdieck, M. (March 2003). *Museum of Science, Boston, Current Science & Technology Center: Guest Speaker Series: Remedial Evaluation*. Annapolis, MD: Institute for Learning Innovation.

[16] Storksdieck, M. & Tanguay, M. (May 2003). *Museum of Science, Boston, Current Science & Technology Center: Current Science Theater/Forums. Formative Evaluation Report*. Annapolis, MD: Institute for Learning Innovation.

- A quarter indicated that they had learned specific scientific content.
- Research or science methods were mentioned at a rate of 6%.
- Just one person made reference to "current."

2. Results from feedback forms sampled during summative phase of 2004

We sampled 159 visitors between May and October 2004, representing sixteen topics, nine of which focused on medical science and/or technology (see Table 8). More than have of the respondents in this sample (57%) attended one of the medical presentations, the others attended presentations on technological advancements (21%) and physics and astronomy (22%).

Table 8: Presentations sampled for this study

	Percent (n=159)
Medical science & technology	**56.7**
Nano-medicine	17.6
Frontiers on Friday	13.2
Gene Doping	8.2
Obesity	5.7
Science of Sports	3.8
Xenotransplantation	3.8
Is SARS back?	2.5
Genetically modified food	1.3
Fats of Life	0.6
Technology	**21.3**
Cell phones	9.4
Carbon nanotubes	6.9
Digital Camera	5
Physics & Astronomy	**22.0**
Einstein	7.5
Sedna	6.9
Space Update	5.7
Secrets of Saturn	1.9

3. Visitor demographics and psychographics

Thirty-six percent of visitors who saw the presentations consider themselves occasional visitors to the museum, and 36% identified themselves as regular visitors (including museum members and staff/volunteers). Twenty-eight percent were first time visitors. Fifty-six percent of visitors who saw the presentations were visiting the museum with their families; 32% were visiting with a friend or partner and 11% were visiting the museum by themselves. About half of the respondents (48%) visited with a group that contained children age 17 or younger, and two-thirds of these groups had children age 11 years or younger present. Two-thirds of the respondents, thus, belonged within the narrow target group of adults and children 12 and older.

Roughly fifty-two percent of the visitors who saw the presentations and filled out the surveys were between 25 and 54 years of age. Twenty-seven percent of visitors were 55 years and older. Fifteen percent of visitors were 17 and younger and six percent of visitors were between 18 and 24 years of age. Just six respondents (4%) were younger than 12 years of age and thus outside the target audience for CS&T.

Table 9: Age or respondents

	Percent (n=155)
11 years old and under	3.9
12 - 17 years old	11.0
18 - 24 years old	5.8
25 - 34 years old	11.6
35 - 54 years old	40.6
55+	27.1

Fifty-two percent of respondents were male, 48% female. Eighty-three percent of respondents identified themselves as White or Caucasian, 11% as Asian American or Pacific Islander, 3% as Latino or Hispanic, 2% as Black or African American and 1% as Other or Mixed. The ethnic composition of the sample is thus similar to that of the museum's general visitorship.

Almost two-thirds of respondents (64%) rated their interest in science and technology as "high", and a third (34%) as "moderate." Only two respondents (1%) rated their interest as "low."

4. Satisfaction with live events - rating the presentations

Over half of the respondents rated the presentations as excellent (58%, n=90). Forty percent (n=62) rated the presentation as 'very good' or 'good' (see Table 10). A small number of visitors rated the presentation as 'Fair' or 'Poor' (3%, n=5). Respondents who attended a medical or health related show were more likely to rate the show as 'excellent' than those who attended a science/technology show (68% vs. 52%).

Table 10: Presentations ratings

	How would you rate the presentation (n=159)		
Theme	Excellent	Very Good or Good	Fair or Poor
Medical/Health	68%	36%	2%
Science/Technology	52%	44%	4%
Total	58%	39%	3%

4.1. Reasons for rating the presentations

The majority of visitors who saw the presentation and filled out the survey explained that the presentation was informative, had a good speaker who was clear and organized, or was interesting (Table 11). Only a small percentage (10%, n=10) gave the entertainment value or the fun factor as reason for the rating.

Table 11: Reasons for presentation rating

Reason for Rating Presentation	Percentage (n=155)*
Informative	39
Good speaker	34
Clear/organized	28
Interesting	16
Presentation style was impressive	12
Entertaining/fun	10
Negative reason	16

Note: Total is >100% due to multiple responses. The 155 respondents gave 161 reasons for their ratings

Visitors who rated their interest in science and technology high, or did not bring children to the museum, rated the presentations higher than those who confessed to lower interest in science or who visited with children (Table 12 and Table 13).

⇒ The presentations are most appealing to the target audience of CS&T: adults with interest in science who have the ability to attend to CS&T programming.

Table 12: Presentation rating by interest in science and technology

Rating the Presentations	How would you rate your interest in science and technology?*		
	High (n=97)	Moderate (n=52)	Low (n=2)
Excellent	63%	48%	
Very good; good	34%	50%	50%
Fair; poor	3%	2%	50%

Note: *An ordinal-by-ordinal Gamma test (0.321; $p<0.05$) revealed that ratings were significantly different for different levels of interest in science and technology.

Table 13: Presentation rating by presence or absence of children in group

Rating the Presentations	Do you have children in your group?	
	Yes (n=74)	No (n=82)
Excellent	47.3%	67.1%
Very good; good	48.6%	30.5%
Fair; poor	4.1%	2.4%

Note: *A Chi-Square test ($X=6.2$; $p<0.05$) revealed that ratings were significantly different for those with and without children in the group.

5. Impact on visitors

Similar to the CS&T and MOS exit interviews, impact was determined primarily in two ways: by assessing what it was that visitors took away from the presentation, and by determining their desire to share the experience with others and to pay more attention to topics that were covered during the presentations.

5.1. Learning or what visitors took away from live events

Visitors were asked to list a few key points they took away from the presentation. The open answers were coded in four dimensions: (1) whether the respondents identified and described specific facts or detailed information; (2) whether the respondent merely mentioned a topic but did not elaborate; (3) whether the response indicated an awareness or realization, and (4) whether the respondents described the nature or process of research. It is important to note that learning could not be tested in a more narrow sense, given the broad range of topics presented, nor would such a test be valid for a brief, 10-15 minute free-choice learning experience. Table 14 summarizes the results and breaks out the frequency by the type of topic covered in the presentation, distinguishing between medical and health related topics and those that touched on other aspects of science and technology.

Table 14: Coded answers to the open-ended question on learning from the presentation

Key points of the presentation	Medical/Health (n=63)	Science/Tech (n=50)	Total (n=113)
Specific, detailed content (n=54)	56%	52%	54%
General content (n=31)	35%	26%	31%
Awareness/realization (not necessarily new) (n=29)	32%	18%	26%
Scientific process/research (n=6)	5%	6%	5%
Unrelated/none (n=15)	10%	18%	13%

More than half of the respondents were able to write down one or more detailed facts when describing the key points of the presentation. Appendix 7 provides a complete list of answers to the item "Please list a few key points you took away from this presentation." The list provides impressive evidence for the clarity, quality and appropriateness of the presentations. Answers indicate not only that the live events were able to inform visitors about current (health) science and technology, they are also a clear indication for the breadth of topics covered during the 16 life events.

5.2. Desire to share what was experienced

Half of the respondents (54%, n=83) who considered themselves 'Very Likely' to share what they learned with someone they know and another third (30%, n=47) who considered themselves 'Likely' to share what they learned with someone they know. A small number (16%, n=25) considered themselves 'Somewhat Likely' or 'Not at All Likely' to share what they learned with someone they know (Table 15).

Table 15: Follow-up communication as a result of the presentation

	How likely are you to share what you learned?	How likely are you to watch another of these presentations when it is about something different?	How likely would you be to pay attention to future news about the subject?
	Percent (n=155)	Percent (n=151)	Percent (n=153)
Very Likely	53.5	68.2	62.7
Likely	30.3	23.2	22.2
Somewhat/not at all likely	16.1	8.6	15.0

Two-thirds of respondents (68%, n=103) considered themselves 'Very Likely' and another quarter (23%, n=35) 'Likely' to watch another presentation when the presentation is on a different subject. Only a few (9%, n=13) considered themselves 'Somewhat Likely' or 'Not At All Likely' to watch another presentation when the presentation is on a different subject. Similarly, almost two-thirds (63%, n=96) considered themselves 'Very Likely', and almost a quarter (22%, n=34) 'Likely' to pay attention to future news about the [presentation] subject, which reflects a positive interest in visitors in the presentation topic. Visitors who attended a presentation on medical or health-related topics were slightly more likely to pay more attention to the topic of the presentation than visitors who saw a presentation that was not related to health (see Table 16): 69% of those who saw a health-related presentation checked the 'Very Likely' option, compared to 55% of those who saw a presentation that was not health related.

Table 16: Follow-up communication as a result of the presentation by topic group

	How likely would you be to pay attention to future news		
	Medical/Health (n=86)	Science/Tech (n=67)	Total (n=153)
Very Likely	69%	55%	63%
Likely	22%	22%	22%
Somewhat/not al all likely	9%	22%	15%

Note: *A Chi-Square test (X=5.4; p<0.07) revealed that ratings were almost significantly different between topic groups.

⇒ Visitors took away new insights from the presentations, and more so, they expressed an interest in sharing their new knowledge with others and in following up by paying more attention to similar topics. The presentations, thus, can be considered highly successful. The fact that 93% of respondents (n=143) saw all or almost all of the presentation is an additional indication that visitors appreciate live events at CS&T.

6. How do people find out about the presentations

The majority of respondents (63%, n=95) heard or learned about the presentation after entering the museum. These visitors learned about the presentation from the museum loudspeaker (33%, n=50) or by 'just walking by' (26%, n=39). A smaller number (9%, n=13) heard about the presentation by seeing the speaker on stage or screens above the stage. One-quarter of the visitors (24%, n=36) heard about the presentation upon arrival at the museum. The majority of these visitors learned about the presentation from the museum guide 'Your Visit Today'.

A small number of visitors heard about the presentations before entering the museum (14%, n=21). These visitors learned about the presentation from friends or by word of mouth (7%, n=11), Museum email (5%, n=7), Museum website (3%, n=5), or radio/television (1%, n=1). Eleven percent of the respondents (n=17) reported that they came to the museum specifically for the presentation.

⇒ While too many visitors still learn about live events only when they arrive at the museum, there is a small group of about 10% of attendees for whom the presentation might have become at least one of the reasons for visiting the Museum.

7. Why did visitors choose to attend a presentation?

Fifty-five percent of respondents reported that they attended the presentation because they had interest in the topic (Table 17). Thirty-five percent of visitors attended the presentation because the presentation fit into their schedule. Twelve percent of visitors attended the presentation because they were interested in the presentation style. Less than ten percent of visitors attended the presentation because there was seating available and they were tired, because it was a topic related to their career, it was something for adults and teens, or because someone they knew recommended it to them. Less than 1 percent had other reasons for attending the presentation.

⇒ Visitors attend a presentation when it fits their interest

Table 17: Reasons for attending a presentation

	Percent (n=159)
I am interested in the topic	55%
It fit with my visiting schedule	35%
I was interested in the presentation style	12%
Someone else wanted to see it, I just tagged along	11%
We all wanted to see it (group)	9%
There was seating available and I wanted to rest	9%
It is a topic related to my career	7%
It is something for teens and adults	6%
Someone I know recommended it to me	2%
Other: Knew Presenter	<1%

Note: Total exceeds 100% due to multiple answers

Seventy percent of respondents (n=104) said that this was their first presentation they had seen on the multimedia stage. For the majority of first-time (91%, n=38) and occasional visitors (83%, n=44) this was the first presentation they saw on this (or a) multi-media screen. Ten percent (n=4) possibly misread the question and said that although they considered themselves a first-time visitor, they had seen presentations on a multimedia stage before. Regular visitors were about split between those for whom this was not the first presentation they had seen on this multi-media stage (58%, n=30) and those for whom this was the first presentation they saw on this multi-media screen (42%, n=22). Regular visitors are thus becoming familiarized with presentations on the CS&T multimedia stage (see also Table 18).

⇒ Regular visitors to the Museum are becoming familiarized with presentations on the CS&T multimedia stage.

Table 18: Novelty of presentation versus frequency of visitorship

	Is this the first presentation you saw on this multimedia stage?	
Type of Visitor	Yes (n=104)	No (n=43)
First-Time Visitor (n=42)	90.5%	9.5%
Occasional Visitor (n=53)	83.0%	17.0%
Regular Visitor (n=52)	42.3%	57.7%

Study 3: Engagement with CS&T exhibits - Tracking and Timing

1. In visitors' own words…

Observing visitors is akin to letting them vote with their feet. Their decisions to pay attention to elements of an exhibition, and their level of engagement with exhibits, is often seen as an important overall gauge for the attractiveness of an exhibition. Unobtrusive observations that track and time visitors and that record their activities within a predefined area may not allow one to assess the exhibition in absolute terms, but do provide an indication of the relative strength of its elements. Since observations don't allow for the visitors' voice, researchers also asked during the exit interviews what respondents had done while in CS&T. The answers of 46 visitors were recorded and are presented verbatim in Appendix 8. The answers not only make clear that all of the elements in the CS&T exhibit area were attractive to some visitors, they also speak of the enormous potential for learning and exploration that CS&T afforded its visitors. The following provides a few select quotes from visitors' description of their experiences in CS&T:

> *[Presentation on gravity probe]. Was good, not too watered down. Not dumbed down; excellent on visuals; I liked the clip thing, the membrane table he demonstrated with, I liked the real model of spacetime and the multiple screens, I didn't know about this before. Question: how does this probe relate to my life? What's the point spending money on it? From a science perspective it's useful, though not practical; the use may come later.*
>
> *Heart; water filters, surgery tools, meteorites, TV screens, e-coli touchscreens (how to use e-coli to die denim). I liked the touchscreens but went to explore further. The artificial heart is fascinating, scary to have man-made thing in the body. Water filter is simple, that's what most people want, its so basic, a God-sent for people in developing countries.*
>
> *The presentation was clear and entertaining; kids liked it; I liked the water filtration, the fact that ceramic is more effective and only costs one dollar, kids saw and liked medical technology.*
>
> *I saw a presentation; the gravity probe and how it works, Einstein's theory, whether he was correct. The presenter told us about the process of research. Nice to have someone talk to you, you don't have to read and he made it easy to understand something that I normally wouldn't understand.*
>
> *Surgery tools: It's good knowledge to actually see tools and experience the hands-on; water filtration. Wife found information about nanotechnology on a touchscreen. The artificial heart: I liked the problem-solving approach. In general, the exhibition gives a broad sense on how science is trying to fix problems.*
>
> *Touchscreens: they were easy to read and use and they were fun. The kid went to the touchscreen and we followed the kid. The water filter was cool. The Gecko hands and toes that may lead to new adhesives; the general review of health issues; read about worms eating [illegible].*
>
> *I tried surgical tools. I liked the water filter; I lived in Africa, so I appreciated it. It's a simple and cheap water filter technology, compared to what's been done right now with iodine. I heard about e-ink on NPR. I liked the AbiCor heart and the miniature camera; I knew something about it, I may be using the camera for work.*

I used the touchscreen; that was interesting. I used it for five minutes, read about experiments they conduct in Antarctica about the climate from the past. There were several other stories; I listened for a few minutes to a presentation, then went to screens and later looked at an exhibit on water filtration.

Water filtration, I read about it in the Boston Globe last year. A woman from MIT worked on it, I remembered that. The kids are playing, they enjoy it. It's interesting, it's happening, it provides little capsules of new ideas.

I looked at information on diabetes on the computer (I am diabetic); what they have been doing recently to treat it; that was very useful. I enjoyed doing this, it helps, I just happened to walk by when the screen was set on diabetes. We walked around and caught parts of two presentations in the afternoon. One was on SARS. I didn't stay, stood for only a few minutes.

2. Demographics of the sample

Tracking and Timing data were collected for seventy randomly selected visitors. Overall, most (70%) of the tracking and timing visitors were part of a group that included adults and children. The remaining individuals were part of an adult only group (24%), a child only group (3%), or simply adults visiting alone (3%).The majority (85%) of tracked visitors were over the age of 18 (63% between 18 and 50, and 22% over 50). Five percent of tracked visitors were under the age of 12 and the remaining 11% were between the ages of 13 and 17. Nearly all (95%) of the visitors were Caucasian. The 5% of non-white tracked visitors were American Indian (3%) and Latino (2%). The sample was nearly evenly split between males and females (51% and 49%, respectively). The demographics of the sample reflect the museum visitorship demographics as a whole, though it does not reflect the overall diversity of museum visitors since sampling was done at times when school groups mostly did not attend the museum. Tracking and timing data included time spent at the CS&T exhibit, number of visitor stops at each element (attracting power), and level of visitor engagement while at each exhibit element. Data are reported in detail below.

3. Time spent in the CS&T exhibit area

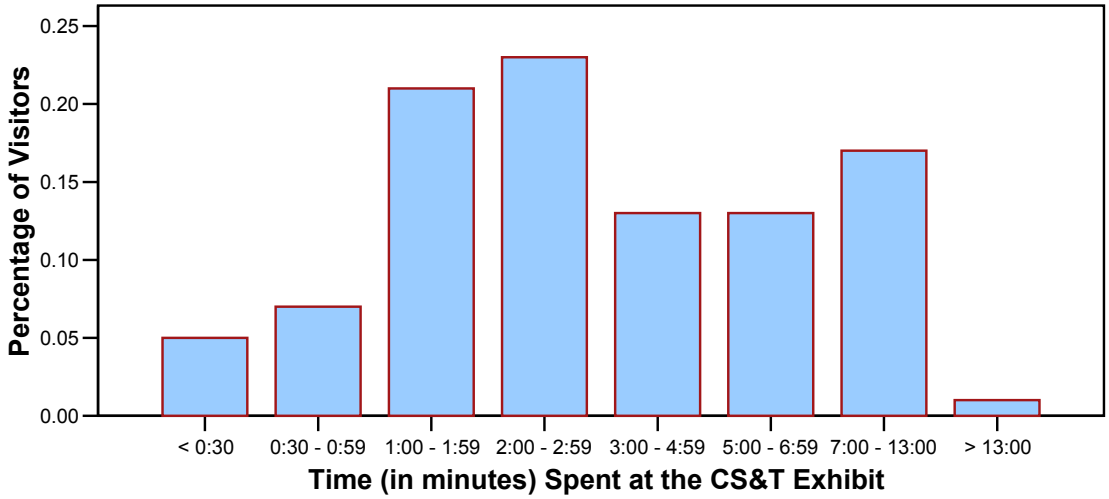
Tracking and timing data included the amount of time visitors spent at the entire exhibit area but do not include the time visitors spent attending live presentations (which were meant to be the main educational element of CS&T and which had enormous holding power). Visitors, on average, spent 4:21 minutes[17] in the CS&T exhibit area. This average is slightly skewed due to a 60-year old man who spent nearly an hour (54 minutes) at the Touchscreen Triad[18]. In response to the effects of this large outlier, the median statistic is reported and believed to be more representative of the central tendency in the data set than average time spent in CS&T. Half of the CS&T visitors spent 2:00 or less at the exhibit and times ranged from under 30 seconds (the visitor basically passed through the space) to 54 minutes (see Figure 1).

Serrell found that visitors on average spent about 12 minutes in a science center exhibition (N=14, average size = 3900 sf, 32 exhibition elements) and about 16 minutes in the average science museum exhibition (N=20, average size = 4221sf, 39 exhibition elements).[19] CS&T is a considerably smaller space, with only 12 individual exhibit elements at the time of tracking, and it serves as a major crossway between other parts of the museum. Both of these factors and the fact that the stage provided for the main

[17] This average is based on eighty-seven percent of visitors (time spent was not recorded for the remaining 13%).
[18] This visitor might incidentally and independently have been interviewed later during an MOS exit interview. He was likely the person who described reading up on diabetes on the touchscreen.
[19] Serrell, B. (1998). Paying Attention: Visitors and Museum Exhibitions. [Professional Practice Series (Adams, R., Ed.)]. Washington, D.C.: American Association of Museums.

attraction explain the brief dwell time of visitors, and also need to be considered when assessing the value of the exhibit area for visitors. Still, the data indicate that a large percentage of visitors stroll through CS&T, paying occasional attention to select exhibit elements and then moving on to their envisioned destination. The data might be slightly misleading: if CS&T were confined to a defined and identifiable area, fewer visitors might choose to visit it, and then stay longer. The way CS&T is currently located, more visitors are exposed to CS&T, and while only approximately a third spent more than 5 minutes in CS&T, many did pay attention to few exhibits that might have otherwise not come across them. It should also be noted that unobtrusive observations were not conducted during times of presentations. Informal observations indicate that visitors might have spent considerably more time in the CS&T exhibit are before and immediately following presentations on the media stage.

Figure 1: Percentage of visitors who spent specified amounts of time at the exhibit



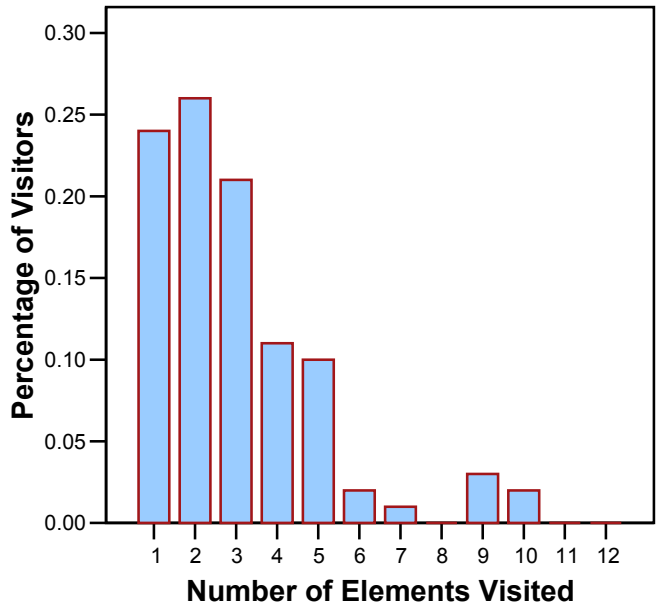
Several median tests were preformed to discern whether the median split for time spent was related to any demographic factors. A two-way contingency table analysis was conducted relating time spent to each of three demographic variables: age, gender, and group type. There was not enough variety of visitor ethnicities to run any meaningful comparisons with this fourth demographic variable. Those whose time spent at the exhibit fell at or below 2:00 (the median) were classified as short-time visitors and those who spent more than the median time in the exhibition were classified as long-time visitors. There were no significant relationships between long- or short-time visitors and age group or gender, $X^2(1)=1.62$, p=0.36 and X^2 (1)=.01, p=0.79, respectively. There was a significant relationship between time spent at the exhibit and whether or not visiting groups included children, X^2 (1)=5.03, $p<0.05$. Results suggest that groups of visitors with children typically spent less time in the exhibit (below the median time spent) than adult-only groups of visitors.

⇒ Visitor observations indicate that CS&T is more attractive to adult-only visitors than visitors with children.

4. Attracting power of exhibits

CS&T visitors typically visited between two and three exhibit elements (mode=2.5 and mean=3) (see Figure 2). At most, visitors stopped at ten of the twelve elements. The majority of visitors approached between one and five elements and only a few visitors approached six or more.

Figure 2: Percentage of visitors by number of elements approached



Some of the exhibit elements were more commonly approached than others (see Table 19). The greater number of visitors to stop at an element is indicative of greater attracting power. The elements with the highest attracting power (approached by more than 25% of the visitors) were: Audio Spotlight, ABIOCOR Heart, Portable Ultrasound, MIS Tools, Low-Cost Water Purification, Touchscreen Triad, and E-Ink. The exhibits with the lowest attracting power were the CS&T Survey Computer, the Design That Matters projector, and the Capsule Camera.

The CS&T team was especially interested as to whether the Touchscreen Triad was more attractive (or less attractive) to a certain age group of visitors. Visitors in different age groups (younger than 18 and older than 18) did not differ significantly in visitation of the Touchscreen Triad, $X^2(1)=0.03$, p=0.86. These results suggest that the Touchscreen Triad is equally attractive to youth and adults. However, due to the low number of younger visitors, these results need to be considered as preliminary and subject to further study.

5. Engagement level

Engagement levels were recorded for each visitor stop (see Table 19 for average engagement levels). Engagement level was rated on a scale of one to four with one being low engagement and four being high engagement. Note that in a few cases, engagement ratings were missing; therefore, the count is provided in Table 19 for the engagement level at each element.

Visitors' engagement levels were fairly moderate at nearly all exhibit elements. The exhibits that encouraged moderately high to high engagement levels for more than half of the visitors were: Design That Matters, MIS training Box, and E-Ink. Of those that encouraged higher levels of engagement, only one, E-ink, had high attracting power as well.

Generally, the AbiCor Heart, Portable Ultrasound, and Audio Spotlight evidenced higher levels of attracting power but lower levels of visitor engagement. The MIS training box and Design That Matters projector both evidenced lower levels of attracting power but higher levels of visitor engagement.

⇒ It may enhance the visitor experience if the more engaging elements in the CS&T exhibition are displayed nearer to the center of the exhibition to increase the number of visitors who stop at these more engaging exhibits.

Table 19: Attracting power and engagement level by exhibit element

Attracting Power		Engagement Level**		
Exhibit element	% of visitors who stopped (# of visitors)*	Exhibit element	Mean engagement level (number of tracked individuals who received an engagement score)	% of visitors who stopped with moderately-high to high engagement levels
ABIOCOR Heart Non-interactive, an artificial heart pump in a small case	47% (33)	E-Ink Non-interactive example of a flexible page that can display info	2.7 (n = 28)	57%
E-Ink Non-interactive example of a flexible page that can display info	40% (28)	MIS Training Box Interactive, remote surgery tongs	2.6 (n = 11)	50%
MIS tools Non-interactive, surgery tool diorama	34% (24)	Design That Matters- Non-interactive projector	2.2 (n = 6)	50%
Low-Cost Water Purification Non-interactive, multiple objects contrasting a Brita filter system with a low-cost ceramic version in Africa developed by MIT researcher	31% (22)	MIS tools Non-interactive, surgery tool diorama	2.5 (n = 24)	46%
Audio Spotlight Interactive experience about 3D audio	29% (20)	Low-Cost Water Purification Non-interactive, multiple objects contrasting a Brita filter system with a low-cost ceramic version in Africa developed by MIT researcher	2.5 (n = 22)	45%
Portable Ultrasound (SonoSite) Non-interactive, a small gadget	29% (20)	Touchscreen Triad Interactive	2.3 (n = 16)	44%
Touchscreen Triad Interactive	26% (18)	Audio Spotlight Interactive experience about 3D audio	2.5 (n = 20)	40%
MIS Training Box Interactive, remote surgery tongs	16% (11)	ABIOCOR Heart Non-interactive, an artificial heart pump in a small case	2.2 (n = 32)	38%
Mad Cow Video Non-interactive video	16% (11)	Capsule Camera (Pill Cam) Non-interactive, tiny in-body swallow camera	2.5 (n = 6)	33%
Capsule Camera (Pill Cam) Non-interactive, tiny in-body swallow camera	9% (6)	Portable Ultrasound (SonoSite) Non-interactive, a small gadget	1.6 (n =20)	15%
Design That Matters- Non-interactive projector	9% (6)	CS&T Survey Computer	1.5 (n = 2)	0%
CS&T Survey Computer	6% (4)	Mad Cow Video Non-interactive video	1.1 (n = 10)	0%

*n = 70

**Engagement levels: 1 = low; 2 = moderately low; 3 = moderately high; 4 = high

Study 4: Assessing the partnership - Perspectives of participating scientists and institutional partners

In order to assess the nature of the partnership between CS&T, its institutional partners and the many individual scientists who agreed to present their research at the Museum, in-depth interviews were conducted with a select sample of individual scientists and representatives of the various institutional partners.[20]

1. Participating scientists

Institute researchers spoke with twelve scientists who presented as part of the CS&T program, and sought information on their reasons for participating, initial goals, the quality of their experience, benefits and trade-offs of participation, suggestions for improving the program, and suggestions for a presenter training session. Following is a detailed description of our findings based on these interviews.

1.1. Reasons for participating and initial goals

Scientists were asked to talk about their reasons for participating in the CS&T program, their initial goals, and whether or not they felt their goals had been achieved. Scientists offered both professional and personal motivations and goals, some of which overlapped with the partners' perspectives. The most common motivating factor was the desire to communicate about science—or a particular research topic—to the general public. Scientists talked about wanting to help people better understand issues in science and make informed choices, create more awareness, encourage healthier lifestyles, get people excited about science topics, inspire people to change behaviors, and even to build citizenship. Some representative quotes include:

> *[My goal was] educating the public, both about…my field of research and also hopefully to entice them into ideas about science and research in general.*
>
> *[There are] lots of issues that warrant better understanding. Stem cells, genetic privacy…they are relevant to peoples' lives. [People] need to understand science for voting and citizenship.*
>
> *It's important for the academic community to engage, involve and informally educate the public. The public needs to be more involved [in science]…Museums are the perfect partner for this and a match made in heaven.*

In addition, a few scientists said they were motivated to participate in CS&T because they enjoy teaching and interacting with a general audience; some felt it would help achieve their home institution's mission to do public outreach; and a couple of scientists hoped to learn how to communicate more clearly to the general public and make complex topics accessible and interesting.

[20] The institutional research partners were: Dana-Farber Cancer Research Institute, Harvard-M.I.T. Division of Health Sciences and Technology, Harvard Medical School and its teaching hospitals, Harvard School of Public Health, Massachusetts General Hospital, McLean Hospital, and the Whitehead Institute for Biomedical Research. Media partners included the journals *Nature* and *Science*, the *New England Journal of Medicine*, ABC NewsOne, ScienCentral, and New England Cable News.

Finally, most of the scientists thought they had achieved their initial goals. Those who were strongly motivated by educating the public felt particularly satisfied when the audience seemed interested and engaged during the presentation. Some scientists were less sure if they had achieved their goals, pointing out that they did not get enough feedback or sense of their impact on the audience. Only one scientist reported not achieving their goal of impacting the public because they felt the talks were not frequent enough to do so.

1.2. Benefits and trade-offs of participation

All of the scientists interviewed said they enjoyed their overall experience with CS&T. Some of the specific aspects they liked include: conveying information about science or their particular research, working with other scientists, and interacting with the public. In addition, almost all said they would recommend participating in CS&T to their colleagues and/or liked the program enough to do it again. Following are a couple of representative comments:

> *I liked it…I'm an educator, and I enjoy the opportunity to talk to the public and folks who are coming to learn something as well as to be entertained. I thought it would be a good crowd and generally it is.*
>
> *I like to talk about what I do…Adults and kids are interested in the topic, and I get satisfaction in talking to people who are engaged.*

Scientists also mentioned other benefits, such as improving their communication skills; increasing their excitement about science and their own research; and getting more exposure to the "real world."

Almost none of the scientists said there were trade-offs for participating in the CS&T program; and just a couple noted that it was "nothing significant," such as giving up a little free time for preparing and presenting.

Researchers also asked scientists to rate their overall experience on a 6-point scale, with 6 meaning "excellent" and 1 meaning "unacceptable." The majority of scientists rated the experience "good"; 1 scored it as "very good"; and 2 as "excellent." No one gave a score of "fair" or lower. When asked to explain why they gave the score that they did, both positive and negative perceptions of the CS&T program emerged. The positive feedback included that the program was an excellent idea, provided visitors with good current information, and created a stronger connection between scientists and the public. Some of the more negative aspects included comments such as: the program was not implemented as well as it could have been, the lecture-oriented format did not engage the audience enough,[21] and the partnership aspect did not feel like a high enough priority for the museum.

1.3. Suggestions for program

Scientists offered several suggestions for enhancing the program. While there was no strong pattern or trend, the most prevalent comment was that the presentations should be more hands-on and interactive, should encourage more conversation and discussion, and should be less lecture-based. Additional suggestions included offering presentations more frequently, adding evening debates or panel discussions (rather than a presentation format), putting more effort into advertising and marketing the presentations, and offering a one-year museum membership to presenters.

[21] Note that most guest speaker presentations were not in a strict lecture format.

1.4. Suggestions for training session

Institute researchers asked scientists to describe what would be useful to cover if the museum provided a training session for presenters. Most of the scientists seemed to like the idea and offered numerous suggestions. They thought the training session should include the following: tips on making complex science issues accessible to a general audience; specific training on how to organize a presentation and engage an audience; provide a list of bulleted points on what makes a good talk or "what works"; video tapes of 2-3 good presentations that scientists could use as models; information on who their audience is and what their needs are; and some training in how to use the technology and equipment.

1.5. Summary

a) How they became involved:

- Contacted by museum
- Replied to institutional ad or flyer, looked interesting
- Scientist's work was featured in a newspaper or other publication
- Scientist had long, ongoing relationship with museum, prior connections

a) Reasons for participating and initial goals:

- Enjoy teaching, interacting with general audience
- Want to communicate about science (or their specific research topic) to general public
- Want people to make informed choices, understand science – particularly relationship to politics/citizenship
- To encourage healthier lifestyles, inspire people to change behaviors
- Create more awareness, get people to care, understand relevance of science issues to their lives
- Educate people, get them excited
- Promote home institution's goal of outreach work
- Learning how to communicate more clearly to general public, compress complex issues into short format, put together a clear presentation

Where personal goals achieved:

- Most said yes – especially when audience seemed interested, excited
- Some weren't sure – got some good feedback, but not enough sense of success or impact
- One noted that it's an ongoing process, always improving
- One noted that they did not achieve goals because the talks were not frequent enough

b) Benefits and trade-offs of participation:

How they liked it:

- All said they liked it – conveying information to audience, working with scientists, talking to public
- All liked it enough to come back, do it again
- One mentioned some negatives – poorly organized, not enough marketing/advertising

Benefits

- Several noted improved communication skills, especially public speaking to a general audience about science topics
- Increased their own excitement about science
- Enjoys talking about what they do

- Some thought it was more a "gift to the community" than something they gained personally from. One noted it was good exposure to "real world," but not important for their CV, professional growth, etc.

Trade-offs:
- Many said there were no trade-offs or nothing significant (e.g., giving up a little free time)
- Giving up research (?)
- Spending a lot of time preparing

Ratings:
- For those who rated the experience, 4 scored it "good"; 1 scored it "very good"; and 2 scored it "excellent
- No one rated it "fair" or lower
- Positives include: excellent idea, good with current info, creates closer connection to scientists
- Negatives include: not implemented as well, could get more mileage out of the program, do more with it, format doesn't engage audience as much as it could, doesn't really feel like a partnership with shared goals, didn't seem like a high enough priority to museum

c) Suggestions for improvement:
- More hands-on, discussion/conversation, interactive
- Less lecture
- Provide evening debates/panels on topics with moderator
- More communication with scientists
- More efforts to advertise talks
- Offer presentations more frequently
- Offer a one-year membership to museum for presenters

d) Suggestions for training session:
- Tips for translating complex science issues to general audience
- Offer ways to engage people more, make them excited and interested
- How to speak to the group, organize presentation, make it tangible; provide list of bulleted points on what makes a good talk, what works
- Offer examples of good talks, such as through 2-3 presentations on video tape
- Give presenters a better sense of the audience – who they are, what their needs are
- Teach logistical stuff better – technology, equipment, where to stand, etc.

e) Other (these come from questions asked to some scientists, but not all of them):
- Most said they would recommend this experience to their colleagues and/or would do it again themselves
- Most said learned something new about communicating science to general audience, improved presentation skills
- Some thought staff were very helpful in preparing, getting things set up, facilitating; a couple felt they were fairly busy and not always helpful in preparing/set-up

2. Participating institutions/partners

Institute researchers interviewed seven individuals from partner organizations to capture their reasons for participating in the Current Science and Technology (CS&T) program, their thoughts on the benefits and trade-offs of partnering with the Museum of Science (MOS), recommendations for improving the partnership, and any additional feedback on the program in general. Overall, partners fully supported the concept behind CS&T and felt that their mission and goals were closely aligned with those of MOS, particularly in terms of making current science and technology topics accessible and enticing to the general public. Partners also gave useful feedback on ways to strengthen the partnerships and improve implementation.

2.1. Reasons for participation

Most partners felt that the main reason to participate in CS&T was that the program could assist them in their mission to get information out to a broader audience and educate the general public on complex or misunderstood topics. They felt the partnership would create a great avenue for reaching lay audiences and broadening public understanding of science, technology, public health issues, and/or new discoveries. For example, one partner noted that CS&T was "a way to get [their] research to a lay audience, in an easy-to-understand format." Another partner put it as follows: "Communication and education our part of our mission – so it's a good match on missions."

Some partners also mentioned the museum's good reputation as a reason for participating in the program ("Brand is important, and the Museum of Science has a fine reputation"). Other reasons for participation included: positive past experiences with similar programs, getting publicity for their own organization, and the opportunity for graduate students or post-doctoral fellows to gain experience presenting to the general public.

2.2. Benefits of participation

There was some overlap between partners' reasons for participating in CS&T and their assessment of its benefits—a positive sign that partners did receive some of what they hoped to gain from the partnership. For example, several mentioned that the program did give their institution the opportunity to reach out to the general public and make science topics more accessible; and that their scientists were able to make connections with the general public, share their research, and improve presentation skills.

Further, most partners simply valued being involved with a top museum like MOS. They felt they had benefited from having their organization's name attached to the museum in some way and that the publicity through MOS was positive. One partner noted that the program "brings together very fine reputable institution, so it's a win-win situation for everyone…the people in the partnership and the people in communities." The partnering science journals, *Nature* and *Science*, specifically stated that the positive publicity and accreditation of their stories through CS&T were among the greatest benefits of the partnership. Finally, though not prompted, almost all partners spoke highly of MOS staff.

2.3. Trade-offs for participation

Partners did not mention many trade-offs for participating in CS&T. The most common trade-off was utilizing their own staff resources and time, particularly for the journals, which had to invest a great deal of time and resources to communicate current stories to MOS. Journal partners also felt that there were

potential risks surrounding the embargo, but trusted MOS staff and did not experience any problems in this arena. Other institutions mentioned the unpaid time and effort that was required of professors and researchers, but that most were very committed to the cause and thus would not consider this to be a significant trade-off for participating in the program.

2.4. Was the partnership worth it?

Several partners said that it was worth the effort to participate in CS&T, mostly because they feel it is important to do anything that helps increase science literacy and broadens their reach. A couple also commented on the interactive, informative, and accessible nature of the program, and felt it was valuable to be involved in this type of endeavor. The journal partners generally thought the partnership was worthwhile, though one felt the impact had not paid off given their high level of investment.

Others, however, were disappointed in the impact and results of their involvement in CS&T. The reasons partners gave include: (1) they felt the audiences were often too small and not necessarily interested in the topic presented; (2) the environment of the theater could be distracting, with visitors coming in and out during the presentation; (3) they were never certain if they were impacting audiences to the extent they had hoped; and (4) some of the plans they had developed with MOS never panned out due to time and financial constraints, such as extensive online features and exhibitions that would tie-in to presentation materials. One partner summarized some of these issues as follows: "I'm not so sure [we have benefited]. Audiences are small but now we are on good terms with the Museum of Science. Our goal of reaching the public hasn't been met. It's more than audience size – also comprehension. Do they understand and are they distracted? It's a challenging venue for speakers, [being] open and with distractions."

One partner, however, noted that some of the challenges of the CS&T program may stem from broader issues that a museum faces in regards to disseminating information on current science—particularly the fact that many people use the internet and other media sources for the latest science information, rather than going to a museum. [Note that the partners interviewed were not likely to have been familiar with CS&T's cablecasting or web efforts.]

2.5. Recommendations for enhancing partnership

Partners gave numerous suggestions for strengthening and enhancing partnerships in the future. Most of this feedback revolved around better and more frequent communication between the museum and the partnering organization. Specific examples include: providing feedback to speakers, meeting more often to discuss ideas, developing topics together and querying partners more often, and clarifying what the museum expects of its partners. One partner also felt that the MOS staff roles were not always clear or consistent due to staff turnover, and suggested that it be made more clear who their main contact is.

2.6. Summary partner interview results

a) Reasons for participating:

- Matched their goals of broadening public understanding of science, scientific discoveries; good way to reach lay/general audience; mission to get info to public, broader community of communication/education of public
- Approached by museum
- Positive past experiences with similar programs
- Fine reputation of MOS
- Good publicity for their organization

- Help create future scientists
- Opportunity for post-doc training in public speaking/education

b) Benefits of participating:

- For journals (Nature and Science), publicity and broader recognition of stories
- Being involved with a top museum
- For institutions, opportunity to showcase researchers, offer students an outlet to present their work
- Make science and health topics less frightening to public, improve public knowledge, creating more educated community
- Scientists have the change to improve public speaking and social skills, meet with general public, etc.

c) Recommendations for improving partnerships:

- For journals, meeting more often with museum staff to discuss ideas; more personal contact
- Developing a really strong sense of trust (because of embargo issues)
- Providing feedback to speakers
- More collaborative process – developing topics with partners more, querying partners
- Clarify expectations of partners
- More evaluation of program
- More consistent staffing at MOS, so that partners always know who to contact

d) Trade-offs for participating:

- For journals, costs and human resources to set it up, no technical infrastructure, embargo risks (though no real concern with MOS, they said)
- Unpaid time and effort for professors
- A couple interviewees said there were no trade-offs at all

e) Was the partnership worth it? Why or why not?

- Several said yes – it's important to do anything that helps increase levels of scientific literacy; great idea
- Some noted that something got lost in implementation, or felt no results and was thus not worth it
- One felt the talks could have been done by museum staff who were briefed by scientists/professors

f) Other comments:

- Disappointed by impact
- Some original ideas discussed (e.g., online display of info via kiosk, developing actual exhibits) never panned out because of time and money constraints
- One person noted that problems may stem from fact that museum is not where people go for latest science info, but use computers/internet

4. Conclusions and recommendations

Does CS&T provide an effective mechanism for communicating current health science in a science center setting?

This was the major research question behind the evaluation and the results of this study indicate that it does. CS&T utilizes a variety of communication means, including staged live events of various types, exhibits, touchscreens, a website, a newsband and cablecasting through New England Cable News. Through these various means, CS&T reaches substantial public audiences, inside the Museum, at homes and businesses throughout New England, and on the World Wide Web. Along with the large numbers of people reached, CS&T was successful in creating a highly productive atmosphere that led to an unusual quantity of current health science research topics addressed in depth by CS&T staff. The strategy of providing in a science museum an infrastructure that is conducive to high output (such as a stage, multimedia authoring and display facilities, and adequate staffing by highly-educated science communicators) can provide multiple and significant opportunities for public audiences to engage with current health science research.

To make it a more manageable project, this evaluation study focused primarily on CS&T's live events, exhibits and touchscreens, and only gathered cursory data on website use and on the reach and impact of the cable news segments. Within the Museum, it seems that the live events were by far the most powerful engagement mechanism but that the exhibitions were also successful in engaging a smaller portion of Museum visitors in meaningful conversation about current and important areas of science and technology. The data also suggest that CS&T needs more time to brand itself within the Museum community and the larger community of the science and health-attentive public. CS&T is not yet known well enough amongst potential target audiences to develop to its full potential.

CS&T as a model would not be as effective without the cooperation of outside partners and funding mechanisms to support ongoing public communication of research. The partnership that was forged between major science and health institutions and media outlets in the Boston area and CS&T added enormous value and impact to the programming of CS&T, both on stage as well as in the exhibition area. However, the partnership also needed strong support and nurturing, and the evidence suggests that it may not have been used to its full potential. Some partner liaisons felt that there was not enough communication and feedback between the Museum and the institutional partners, while CS&T staff were sometimes frustrated with lack of response from the public communications liaisons at the partnering institutions, who were often very busy with other institutional priorities. In practice, CS&T staff did not limit themselves to research stories developing at partner institutions; the staff took many cues from what was front page news or of current concern regionally and across the nation. From the staff's perspective, the partner liaisons were most helpful in making recommendations to staff for researchers from their institutions who would be exceptionally good public presenters on topics in the news or promising new areas of current research. Overall, the partnership was generally assessed in positive terms, whereby the benefits of the partnership tended to outweigh the cost for most partners and they would recommend this type of cooperation to others. Since these interviews were first conducted, some of the partners who were previously more critical have expressed greater satisfaction with the project. Nonetheless, managing a partnership and partnership expectations amongst so many different institutions necessitates considerable effort on the side of the Museum, and it is essential that sufficient resources be devoted to communication and coordination.

Some elements of the project could not be easily adopted by other museums. The scientific journals involved in this partnership made it abundantly clear that they would only be able to work with a small

number of highly trusted science museums on the issue of embargoed information. Some of the institutions also indicated that part of the value for them lay in the visibility that a partner like the Museum of Science, Boston, provided them with. Smaller, lesser known science museums and similar institutions won't bring that asset into a partnership with nationally acclaimed science research institutions and journals, though local partnerships on a smaller scale may not need it.

The project relied partially on the enthusiasm of numerous scientists in the Boston areas who were willing to present their research to an interested and attentive public. Such partnerships with local scientists could be forged between many science museums and local universities and research centers, though, again, the data suggest that it takes time and effort to ensure that the result is positive for all participants. Not every scientist is skilled at translating his or her research to a general audience, and not every museum staff member is capable of coaching scientists in communication with the public. Also, it takes effort, knowledge and skill to find and select those who will successfully present their science to a general audience. (Conversely, participating scientists and science partners indicated that it takes an institution of the caliber of the Museum of Science to attract the best scientists and to ensure that they believe the project worth their time and effort). However, the data indicate that it is far more accepted than even a decade ago that scientists, even those who still need to establish themselves within their own community of practice, are interested to hone their skills in science communication and that their efforts in this regard are accepted amongst their peers.

While this evaluation comes to the conclusion that the project was successful, it cannot provide a more rigorous measure of success: whether the same amount of resources invested elsewhere and otherwise would have yielded better results. This line of evaluation research has never been attempted, in part because of enormous conceptual problems, but also because of the enormous resources it would require to set up an experimental design that would, ultimately, allow one to compare apples with oranges. It would also be quite difficult to separate out the enormous investment the Museum of Science and its donors made in financing the capital costs of constructing CS&T and implementing its advanced media technology infrastructure.

The results of this research suggests the following, more detailed conclusions:

Acceptance and demand for programming that addresses current science and the process of science/research

- Museum of Science, and particularly CS&T audiences expect and appreciate coverage of current health science research (probably more so than audiences elsewhere).
- CS&T seems to attract a subset of museum visitors who have a particularly high interest in current science. Alternatively, visiting CS&T might raise visitors' awareness of current science in comparison to other museum offerings.
- Many visitors to the museum show an interest in the process of science, though there is no consensus whether the museum is an ideal place to present the process of science. Visitors to CS&T were more likely to have encountered and perceived aspects of "process" or how research is conducted than visitors who did not visit CS&T.

Impact of CS&T on its audience

- Presentations and exhibits afford visitors opportunity for learning and engagement beyond the museum visit.
- CS&T exhibitions and presentations serve as a powerful tool to raise awareness about current research for the majority of visitors. Many visitors "sample" the offerings selectively and retain snippets of detailed and in-depth information, but remain on the surface in most areas, and thus remain on the awareness level of learning. This is by no means unusual and no way different from

general learning from and in museums. Like other museum offerings, CS&T provides its visitors with ample opportunities to deepen their understanding about specific topics, and visitors who bring that level of interest to CS&T could often explore their interest in great detail. However, it should be noted that the majority of visitors to CS&T, the Museum of Science, or any museum, "forage" and scan the museum, and only occasionally dig deeper to satisfy a particular interest.

- The live events on the multimedia stage are highly successful in all of their formats.
- Visitors take away new insights from the presentations, and more so, they express an interest in sharing their new knowledge with others and in following up by paying more attention to similar topics. The presentations, thus, can be considered highly successful. The fact that 93% of respondents (n=143) stayed for all or almost all of the presentation is an additional indication that visitors appreciate live events at CS&T.
- The ratings indicate that CS&T was perceived by visitors as a section of the museum that features current science for adult audiences. The absolute rating of 4.6 on a 6-point scale is surprisingly high, since the exhibition space is somewhat ill-defined for visitors and featured relatively few exhibits.
- The rating explanations reinforce the notion that the exhibition space was not outstanding in comparison to the rest of the museum. Given the location of the exhibition area and the open space design of CS&T in the heart of the Blue Wing, near elevators and on a major crossroad between various well-defined exhibition spaces, the ratings are positive and encouraging.

Audience development and "branding"

- Visitors to CS&T clearly identify CS&T as a place where they can get current science and also see it as place for adult visitors.
- Within the limitations of overall science museum visitorship, CS&T is able to attract its target audience.
- However, regular visitors to the Museum are only slowly becoming familiar with presentations on the CS&T multimedia stage.
- The visitor clearly sees great benefit in having CS&T and other areas that feature current science in the museum, but feels that the museum is not doing enough to advertise this resource within relevant communities.
- Visitors to CS&T trust the information they receive in CS&T.
- Audience development might take more time and needs to include a clear understanding for adult visitors that this area of CS&T provides current and updated information in a style and format that is most appealing to "adult" audiences (12 and up). Better advertising might bring more interested visitors in, though the open space also attracts many who would otherwise not come (museum browsers).
- CS&T still needs time to brand itself. Many visitors are not aware of it and do not strategically plan their visit to CS&T, thus potentially missing what could arguably be seen as CS&T's major attractions: live events that take place on the multimedia stage.
- While "branding" for CS&T has not been very successful yet for general museum visitors, though there is some indication that CS&T is developing some following for their live events, particularly the evening programming. While too many visitors still learn about live events only when they arrive at the museum, there is a small group of about 10% of attendees for whom a live CS&T event might have been at least one of the reasons for visiting the Museum.

Assessing true impact

- Measuring the true social impact of CS&T and the efforts of the Museum to play a larger role in interpreting current developments in (health) science and technology for interested adults will take more time and likely needs new approaches to measurement, far beyond what was possible in this project.

Programming issues

- The challenge of an update center is to find a balance between leaving things long enough that sufficient number of people can see it, and the need to refresh content. An update center breeds the expectation that every visit would bring something new, and depending on the visit frequency, this will only be possible to a limited extent.
- Much of current medical technology is connected to a brand. Though only few visitors mentioned it, and even fewer in critical terms, museums need to find a balance between featuring technology and featuring a brand. Naturally, featuring the brand lies in the interest of companies that are willing to donate their equipment (Phillips, Abiomed etc), yet a museum exhibit should not invoke the image of a trade-show. CS&T handled this issue by mostly stressing generic names for featured technologies, and by including technologies from many different companies in their exhibits.

Design issues

- The CS&T multimedia stage is ideally located to attract passers-by and to create an inviting atmosphere that allows visitors to attend a presentation and to leave whenever they feel like it. However, the stage's openness is also its largest liability. A high and unavoidable level of surrounding noise is distracting to visitors, and the sound that emerges from activities on stage can distract visitors of nearby exhibitions. While CS&T has experimented with the location and direction of loudspeakers, more work may be needed to address this problem.
- The CS&T exhibition format appeals to science-interested adult audiences who appreciate the ability to dig deeper for more information and who don't need hands-on interactives to satisfy their needs. Visitor observations also indicate that CS&T is more attractive to adult-only visitors than visitors with children.
- When visitors identified CS&T as "more for adults" they were split in making this determination on positive or negative grounds. The positive perspective was that CS&T provided them with useful and up-to-date information that wasn't "dumbed down" and that fulfilled the need and curiosity of science, technology or health interested individuals. The negative reason why CS&T was primarily for adults was the perceived lack of hands-on and interactive experiences, something parents particularly lamented.
- CS&T would therefore need to address some design contradictions, the most important one is the fact that many potential targeted visitors – at least so far and still – visit the museum with younger children and find the area of CS&T overall not particularly attractive for these children, and, since they visit with children, are prevented from spending time at CS&T. CS&T and similar institutions can counter this effect by providing child-sensitive hands-on experiences nearby that allow parents to focus on the contemporary exhibits while supervising the children.
- It may enhance the visitor experience if the more engaging elements in the CS&T exhibition are displayed nearer to the center of the exhibition to increase the number of visitors who stop at these more engaging exhibits.

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6. Appendices

Appendix 1: CS&T Exit Interview Questionnaire

Appendix 2: Museum Exit Interview Questionnaire

Appendix 3: Presentation Feedback Form

Appendix 4: Tracking Guide

Appendix 5: Scientist Interview Questionnaire

Appendix 6: Science Partner Interview Questionnaire

Appendix 7: Learning from life events (detailed answers)

Appendix 8: Visitor activities in CS&T (details)

Appendix 1: CS&T Exit Interview Questionnaire

1. Do you know what this area you have just browsed in is called (potentially show)?

❒ Yes	❒ No (describe it if answer is no)

2. Casually ask: Have you been in the CS&T before today's visit?

❒ Yes	❒ No

3. Had you heard about CS&T before your visit today ❒ Yes ❒ No

4. Did you intend to visit CS&T when you came? ❒ Yes ❒ No
If yes, when (before or after they arrived)? ❒ Before arriving at MOS ❒ After arriving at MOS

5. You just exited this area (we call Current Science and Technology Center). Can you tell me or show me what you did in there? [Create running list, ask whether they liked things and why]

6. What do you think the CS&T is about? [If not clear, ask: If you had to describe this area to a friend who wants to know what the museum offers to a visitor, how would you describe CS&T?]

7. In your judgment, is this area in any way different from the rest of the museum? ❒ Yes ❒ No
How or how not?

8. Compared to other areas of the museum, how would you rate this CS&T area?

							Why?
Better	❒	❒	❒	❒	❒	❒	Worse
More interesting	❒	❒	❒	❒	❒	❒	Less interesting
Better for adult	❒	❒	❒	❒	❒	❒	Better for children
Current science	❒	❒	❒	❒	❒	❒	Textbook or established science

9. On a scale of 1 to 6, how would you rate the CS&T overall (star rating for movie)?

(Fascinating)					(Boring)
6	5	4	3	2	1

Why did you choose that rating?

10 From where did you learn about CS&T?

Museum loudspeaker announcement "Your Visit Today" map and flyer Other flyers On the screens above this stage	Just walking by From a friend / word of mouth Website (www.mos.org/cst) Radio, TV or Newspaper
Others, *please specify*	

11. What did you like best about CS&T today?

12. Do you think you would visit CS&T again? ❒ Yes ❒ No

13. Tell me one thing that you learned or found out in the Center that you didn't know before or that was refreshed in your memory.

14. How likely do you think it is that you would pay attention to future news about something you heard in CS&T?

❒ Very likely ❒ Likely	❒ Somewhat likely ❒ Not likely

15. Can you compare CS&T with other experiences you had previously? What would you say was a similar experience you had, or what was comparable to CS&T, here or elsewhere?

16. On a scale of 1 to 6, please rate the following statements.

Reliability. With respect to the accuracy of the current science and technology information presented here,					
I can trust the information					I cannot trust the information
6	5	4	3	2	1
Fairness. With respect to the current science and technology information presented here,					
I think the CS&T is fair and unbiased					I think the CS&T advocates a point of view
6	5	4	3	2	1

17. Were your expectations for the CS&T met? Why/How? Why not/How not?

18. Do you watch New England Cable News? ❒ Yes ❒ No
Have you ever seen anything about CS&T on NECN? ❒ Yes ❒ No ❒ Don't know
Did it affect your decision to come to the CS&T or Museum? ❒ Yes ❒ No

19. Have you visited the MOS website? ❒ Yes ❒ No
- Why did you visit the website?

20. Have you visited the CS&T website? ❒ Yes ❒ No
- Why did you visit the website?

Did the website fulfill your expectations?

❒ Yes	❒ Somewhat	❒ No

21. The title of the Center indicates that we are presenting "current science and technology" and we have discussed this a little bit. What do <u>you</u> consider as "current"? or What makes it "current"?

22. How interested are you in "current" science and technology?

Highly interested	Moderately interested	Not or little interested

23. How interested are you in science and technology in general?

Highly interested	Moderately interested	Not or little interested

24. What areas of science or technology are you most interested in? (probe a little deeper: is this situated or general)

25. Why are you interested in this? (probe for level of personal connection: Would you say your interest is more guided by specific personal need, a general appreciation for science, a general interest in learning, or a desire to support someone else's need (family member, friend))

26. Do you follow science or technology in general or health-related issues in the news?

Science/technology in general	❒ A lot	❒ Somewhat	❒ Little to none
Health-related issues	❒ A lot	❒ Somewhat	❒ Little to none

27. Do you find it easy or difficult to understand science, technology or health related issues in the news?

❒ Easy	❒ Somewhat difficult	❒ Difficult

28. To what degree do you think the museum provides you with up-to-date, current information on science, technology and health?

A lot	Little to none
Somewhat	Don't know

29. Is this important to you? [How important is it to you that the museum provides you with current or up-to-date science or health news?]

Very important	Somewhat important	Little to not important

30. In your best estimate, and as much as you found up-to-date science/technology here, was the information useful to you?

A lot	Somewhat	Little or not

31. Here is our big question: Do you think that your experience here at CS&T gave you a better sense of how scientific research is conducted?

32. Please list a few key points you took away from this presentation.

About yourself

What made you want to come to the Museum of Science today?

Is this visit primarily for you, or are you here for someone else's benefit?

- ❒ Me
- ❒ Other: _____

- ❒ Mixed: _____

Are you a (please check all that apply)

- ❒ First Time Visitor
- ❒ Occasional Visitor
- ❒ Regular Visitor
- ❒ Museum Member
- ❒ Staff/Volunteer

Where are you from?

- ❒ Local (within Rt. 128)
- ❒ Regional (within Rt. 495)
- ❒ In-state or neighboring state
- ❒ Out-of-state (non-neighboring)
- ❒ Outside the US

How old are you?

- ❒ 12 - 17 years old
- ❒ 18 - 24 years old
- ❒ 25 - 34 years old
- ❒ 35 - 54 years old
- ❒ 55+ years old

Would you describe yourself as?

- ❒ Asian American or Pacific Islander
- ❒ Black or African American
- ❒ Latino or Hispanic
- ❒ Native American
- ❒ White or Caucasian
- ❒ Other or mixed

Thank you so much for your help. Please take this gift as a token of our appreciation.

Also,
In 4-6 weeks, we would like to call visitors and talk with them further about their experiences with this exhibit. Would be willing to participate in a follow-up phone interview?

❒ Yes ❒ No

Name	
Phone Number	
Email	
Best time to call	

Postscript: Researcher notes

Postscript: Researcher notes

Time of interview: _____ **Date of interview: _____**

Respondent was

- ❒ With family
- ❒ With friend/partner
- ❒ Alone

If children were presented, estimated age of youngest child in group: _____

Sex of respondent:

- ❒ Female
- ❒ Male

Any notes, observations:

Appendix 2: Museum Exit Interview Questionnaire

1. What made you want to visit the Museum of Science today?

2. Is this visit primarily for you, or are you here primarily for someone else's benefit?

❒ Me	
❒ Others:	
❒ Mixed:	

3. Have you heard of the museum's new area called Current Science and Technology Center, or CS&T?

❒ Yes	❒ No (describe it if answer is no)

4. Did you get a chance to visit this area called CS&T? (prompt with descriptions of exhibit space including location)

❒ Yes (Skip to Q. 5)	❒ No

If NO. (Continue and then skip to Q. 12, then 14)
Did you pass by this CS&T area? ❒ Yes ❒ No ❒ I'm not sure
Were there any particular reasons why you did not spend time in the CS&T today?

5. (If Yes to Q. 4): What drew you to CS&T?

6. Compared to other areas of the museum, how would you rate this CS&T area?

								Why?
Better	❒	❒	❒	❒	❒	❒	Worse	
More interesting	❒	❒	❒	❒	❒	❒	Less interesting	
Better for adult	❒	❒	❒	❒	❒	❒	Better for children	
Current science	❒	❒	❒	❒	❒	❒	Textbook or established science	

7. On a scale of 1 to 6, how would you rate the CS&T overall (star rating for movie)?

(Fascinating)					(Boring)
6	5	4	3	2	1

Why did you choose that rating?

8. Did you know about the CS&T Center prior to your visit to the Museum of Science today?

❒ Yes	❒ No

9. From where did you learn about CS&T?

❒ Museum loudspeaker announcement	❒ Just walking by
❒ "Your Visit Today" map and flyer	❒ From a friend / word of mouth
❒ Other flyers	❒ Website (www.mos.org/cst)
❒ On the screens above this stage	❒ Radio, TV or Newspaper
❒ Others, *please specify*	

10. Have you been to CS&T before today's visit? ❒ Yes ❒ No

11. Do you watch New England Cable News? ❒ Yes ❒ No
Have you ever seen anything about CS&T on NECN? ❒ Yes ❒ No ❒ Don't know
Did it affect your decision to come to the CS&T or Museum? ❒ Yes ❒ No

12. Have you visited the MOS website? ❒ Yes ❒ No

- Why did you visit the website?

13. Have you visited the CS&T website? ❒ Yes ❒ No

- Why did you visit the website?

- Did the website fulfill your expectations?

❒ Yes	❒ Somewhat	❒ No

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14. The title of the Center indicates that we are presenting "current science and technology" and we have discussed this a little bit. What do you consider as "current"? or What makes it "current"?

15. How interested are you in "current" science and technology?

❒ Highly interested	❒ Moderately interested	❒ Not or little interested

16. How interested are you in science and technology in general?

❒ Highly interested	❒ Moderately interested	❒ Not or little interested

17. What areas of science or technology are you most interested in? (probe a little deeper: is this situated or general)

18. Why are you interested in this? (probe for level of personal connection: Would you say your interest is more guided by specific personal need, a general appreciation for science, a general interest in learning, or a desire to support someone else's need (family member, friend)

19. Are you interested in how research is conducted or are you interested in the process of science?

20. Do you follow science or technology in general or health-related issues in the news?

Science/technology in general	A lot	Somewhat	Little to none
Health-related issues	A lot	Somewhat	Little to none

21. Do you find it easy or difficult to understand science, technology or health related issues in the news?

❒ Easy	❒ Somewhat difficult	❒ Difficult

22. To what degree do you think the museum provides you with up-to-date, current information on science, technology and health?

❒ A lot	❒ Little to none
❒ Somewhat	❒ Don't know

23. Is this important to you? [How important is it to you that the museum provides you with current or up-to-date science or health news?]

❒ Very important	❒ Somewhat important	❒ Little to not important

24. In your best estimate, and as much as you found up-to-date science/technology here, was the information useful to you?

❒ A lot	❒ Somewhat	❒ Little or not

About yourself

Are you a (please check all that apply)
- ❒ First Time Visitor
- ❒ Occasional Visitor
- ❒ Regular Visitor
- ❒ Museum Member
- ❒ Staff/Volunteer

Where are you from?
- ❒ Local (within Rt. 128)
- ❒ Regional (within Rt. 495)
- ❒ In-state or neighboring state
- ❒ Out-of-state (non-neighboring)

❒ Foreign country

How old are you?
❒ 12 - 17 years old
❒ 18 - 24 years old
❒ 25 - 34 years old
❒ 35 - 54 years old
❒ 55+ years old

Would you describe yourself as?
❒ Asian American or Pacific Islander
❒ Black or African American
❒ Latino or Hispanic
❒ Native American
❒ White or Caucasian
❒ Other or mixed

Thank you so much for your help. Please take this gift as a token of our appreciation.

Postscript: Researcher notes

Time of interview: _____ **Date of interview: _____**

Respondent was
❒ With family
❒ With friend/partner
❒ Alone

If children were presented, estimated age of youngest child in group: _____

Sex of respondent:
❒ Female ❒ Male

Any notes, observations:

Appendix 3: Presentation Feedback Form

How would you rate this presentation? (please check one)

- ❒ Excellent
- ❒ Very good
- ❒ Good
- ❒ Fair
- ❒ Poor
- ❒ Unacceptable

Why would you give this rating?

Please list a few key points you took away from this presentation.

How likely are you to share what you learned with someone you know?

- ❒ Very likely
- ❒ Likely
- ❒ Somewhat likely
- ❒ Not likely

How likely would you be to pay attention to future news about the subject?

- ❒ Very likely
- ❒ Likely
- ❒ Somewhat likely
- ❒ Not likely

How likely are you to watch another of these presentations when it is about something different?

- ❒ Very likely
- ❒ Likely
- ❒ Somewhat likely
- ❒ Not likely

How did you hear about this event? (please check all that apply)

- ❒ Museum loudspeaker announcement
- ❒ "Your Visit Today" map and flyer
- ❒ On the screens above this stage
- ❒ Just walking by
- ❒ From a friend / word of mouth
- ❒ Website (www.mos.org/cst)
- ❒ Radio, TV or Newspaper
- ❒ Other, *please specify* _____

How much of the presentation did you see?

- ❒ All or almost all of it
- ❒ About half of it
- ❒ First part
- ❒ Second part

What made you want to attend this presentation? (please check all that apply)

- ❒ It fit with my visiting schedule
- ❒ It is something for teens and adults
- ❒ It is a topic related to my career
- ❒ I am interested in the topic
- ❒ There was seating available and I wanted to rest
- ❒ I was interested in the presentation style
- ❒ Someone else wanted to see it, I just tagged along
- ❒ We all wanted to see it (if you are in a group)
- ❒ Someone I know recommended it to me
- ❒ Other: _____

Is this the first presentation you saw on this multimedia stage?

- ❒ Yes
- ❒ No

Did you come to the museum specifically for this event?

- ❒ Yes
- ❒ No

About yourself

Are you a (please check all that apply)?

- ❒ First Time Visitor
- ❒ Occasional Visitor
- ❒ Regular Visitor
- ❒ Museum Member
- ❒ Staff/Volunteer

Who are you with today?

- ❒ With my family
- ❒ With a friend/partner
- ❒ Alone

Do you have children in your group?

- ❒ Yes
- ❒ No

How old is your child/are your children? _____

Did any of the children enjoy the presentation? If yes, which age were they?

_____

Are you?

- ❒ Female
- ❒ Male

How would you rate your interest in science and technology?

- ❒ High
- ❒ Moderate
- ❒ Low

How do you describe yourself?

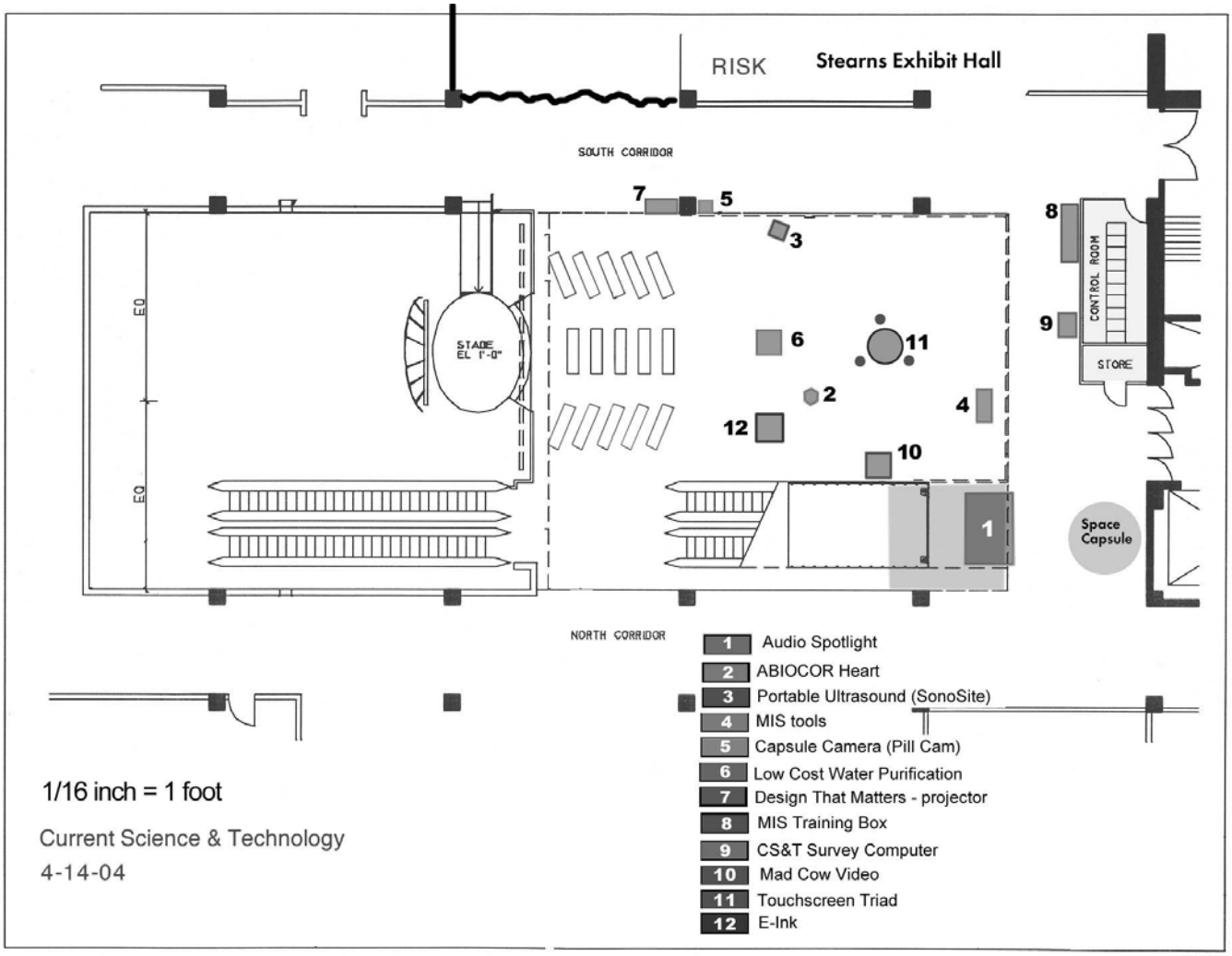
- ❒ Asian American or Pacific Islander
- ❒ Black or African American
- ❒ Latino or Hispanic
- ❒ Native American
- ❒ White or Caucasian
- ❒ Other or mixed

How old are you?

- ❒ 12 - 17 years old
- ❒ 18 - 24 years old
- ❒ 25 - 34 years old
- ❒ 35 - 54 years old
- ❒ 55+ years old

Appendix 4: Tracking Guide

Frontside of Tracking Guide:



Backside of Tracking Guide:

Date: ___/____ /2002 Time in: ____; Time out: _____ Interview # (coordinate with interview): ____; Gender: M F;
Crowdedness (1-4)*: _____ Group size: 1 2 3 4 5+ Group Char.: Alone, Couple, Adult Group, Family Group;
Target Visitor Age group: [10-12] [13-17] [18-50] [50+]; R/E: C; AfA; L; AsA; NPI; O

*Crowdedness is assessed in the following way (assess at the end, since crowdedness can change over time, give an average for the visit)
1) Empty, hardly any visitors present to sparsely visited; others are around but access to exhibits is not compromised
2) Moderately visited; exhibition feels comfortably filled with visitors; noise level is pleasant; all exhibits are accessible (with few exceptions); hardly any wait time for interactions
3) Crowded; moderate noise level; wait time for some exhibits; some exhibits not accessible
4) Very crowded; high noise level; difficult to navigate; many exhibits are inaccessible or crowded, or wait time to see/interact with them

- Record on running list any unusual observation, or any detail that helps us understand the nature of this visit.
- Record time of entering subject areas when people cross the line indicated on the map
- Mark the path with an ongoing line and frequent directional indicators
- Indicate if people look up to banners
- Assess target's "engagement score" and write it next to the exhibit (see below for score definitions). Should target return to exhibit, if appropriate, change the engagement score
- Record whether a social interaction occurred at the exhibit (mark exhibit with an 'S')

- Record whether target took part in presentations and other programming (place arrow into map and record nature of program on the side of the map
- Record whether target had interactions with staff (mark with ‘I’) and other visitors (mark with ‘O’)
- Record any exhibit that visitor was prevented from interacting with (mainly because it was occupied) with a ‘P’.
- Cross out any exhibit that was dysfunctional that day
- Record impression of whether visitor had control over their movement in the exhibition or whether someone else (who?) was deciding on what to do and what to see

Engagement scores from 1-4:
Make sure that the line is drawn accurately in terms of distance to exhibits. We will use the line to determine whether a visitor qualifies as having had a chance to engage at all. There is a profound difference between that (not having been exposed to an exhibit) and engagement score ‘1’.

1 = no engagement: Visitor walks by but pays no to almost no attention
2 = cursory interaction: Visitor stops, glances or in other ways pays some, but little attention, to the exhibit. This may include some level of interaction that does not seem to be related to exhibit message (like cranking a wheel or pushing button without observing results); it may also include a brief glance at a text panel.
3 = intermediate interaction: Visitor engages with less than half the exhibit, or seems to be doing an activity as intended but does not complete it fully, or watches part of a video, or completes part of a computer exercise, etc.
4 = full interaction: Visitor seems to read entire panel text and looks at object; completes computer exercise; watches entire or almost entire video, keenly observes an object; interacts and shows visible signs of mental and not just physical engagement (like reading related signs and panels beforehand or afterwards, discussing results with others, etc). When the visitor has social interactions, place an "s" where those occurred. Feel free to note on the side any detail.

Appendix 5: Scientist Interview Questionnaire

How did you get involved with the CS&T project?

How did you like it?

What were your reasons for participating in CS&T science presentations at the MOS?

What were your goals when you started to give presentations?

Do you think you achieved those goals?

How has the participation benefited you personally and as a researcher/scientist?

What were the trade-offs for participating in the CS&T project?

Have you talked about your experience with your colleagues?

Have you received feedback from your colleagues about your participation in this effort? In other words, what do your colleagues think? Is this important to you?

What are their thoughts on your public outreach efforts?

Do you recommend this type of educational outreach to other scientists? Please discuss why or why not.

Please rate this program as a model for health science communication.

Excellent	Very good	Good	Fair	Poor	Unacceptable

What is your rationale for this rating?

How important or significant is this type of activity for you?

Would you do this again? Please discuss why or why not.

Did you learn something new about communicating science or technology to a general audience?

What was different about addressing this audience to audiences you usually address?

Was it difficult to express your work in simple enough terms to a general audience?

Was the CS&T staff helpful in helping prepare?

What was most helpful?

What would you like more help with next time?

If the museum were to offer training for research scientist on how to communicate research to public audiences, what would you see as most useful/helpful?

How would you improve a program like this. Suggestions for future:

Appendix 6: Science Partner Interview Questionnaire

What were your reasons for participating in the CS&T project at the MOS?
Not yours but your institution (focus on institution)
Was it handed to you or did you pursue you?

How has participation benefited you? (What are the benefits to you for participating in the partnership?)
What was the value in partnering with CS&T in reaching your institutions' strategic priority?
Had the institution received positive feedback from without or outside?
Recommendations for improving partnership

What were the trade-offs for participating in the CS&T partnership?

Overall, was it worth it? Why?

Have you done something similar before, i.e., participated in a partnership with another organization that communicated current science? If yes, could you compare this partnership with your previous experience?

What are your suggestions for improvements, if any?

Would you do this again? Please discuss why or why not.

Is there anything else I haven't asked that might help me understand your perspective on this partnership?

Appendix 7: Learning from life events (detailed answers)

Written answers to the written feedback form item "Please list a few key points you took away from this presentation" by coding area.

Specific Content

- Treatment of cancer without surgery; Doctors able to view beneath the skin before surgery
- Different types of nano-tech therapy; quantum dots; phosphorescent imaging; nanospheres / cancer; cant (? something else, illegible)
- Carbon nanotube is four times tougher than spider silk, 17 times tougher than ... ; Carbon nanotube is very useful for computer memory/hard disk, space elevators
- Dr. Wein... (? can't read), bacteria 20 minutes, lymph node
- carbon modification to bridge earth with satellites
- causes for obesity -- more info on carbs
- calculation of BMI; national statistics about the weight problem
- people are starving but won't use GM food
- Sedna is latest found object and is beyond Pluto; has large elliptical orbit of 10,000 years; takes 10-20 years to revolve
- Sedna's orbit is elliptical; Sedna's distance from the sun; It takes thousands of years for it to orbit the sun
- Sedna has no moons; a planet named Sedna was discovered; Sedna is very cold and remote; Sedna is the largest object discovered since Pluto; farthest planet we know from Earth
- Testing Einstein's theories; Launching of space probe B; made up of gyroscopes
- Gravity probe A tested warpage of ST near heavy objects and was launched 25 years ago
- Jupiter's weather is changing dramatically; Hubble is 14 yrs. old; Hubble and ISS are in totally different orbits
- Gyroscopes use in space exploration; extent of Hubble telescope use
- Rings around Saturn are 300K miles
- Different phone co. have a different system; how towers work; a cell phone is a type of radio
- How it work; about 3 different systems on cell phones
- GMS, how it's transmitted
- (illegible)... (meaning, importance); difference between optical and digital zoom; noisy (?) picture (size); decoy (?)
- Inside visual of digital camera
- Brain looks for patterns and associations during sleep
- It is general information, informative, but not part of a learning process
- brain is working at night to organize and process...without conscious involvement; brain acts "affectively" to organize -- not rationally; we learn this way
- brain function; dream interpretation; memory or memorization techniques
- Sleep consolidates and enhances performance and memory
- definitions of saturated, unsaturated, and trans fats
- Einstein had theories about gravity
- fabric element of space, how mass/gravity connect/interact
- Social impact -- public behavior, handwashing, transit masks; type of virus -- corona; origin of virus -- location, people, trading viral info
- xenotransplantation not available yet; addressing issue of organ rejection; trying to meet growing demand for healthy hearts
- concerns with xenotransplantation; it isn't done today, but maybe in near future; mechanical hearts have been used with limited success
- mechanical hearts are available for direly ill men, not women; pig heart transplants possible, but not in human trails; advantage is rejection-proof

Specific Content and Research Process

- Nanotech in use for cancer research; techniques in many other ways

- Sedna is the largest object found since Pluto; Facts about Sedna, orbit, size; Scientists not sure if it should be classified as a planet; Scientists don't really have stand definition for a planet, perhaps s/b based on size, location & historical planets
- The scientists still don't understand whether Sedna is a planet or not
- We learn during sleep; (2) There is still much we don't know
- risks; what is currently available and what is being trialed

Specific Content and Awareness/Realization

- Nanotechnology is all around us; Cancer treatments are evolving
- How technology is blossoming; how little the general public gets to hear
- Nano-technology applications exist or are close to implementation
- carbon nanotubes are the elevators of the future
- Nanotubes are a new material with interesting properties; could be used for electrical, but also physical purposes
- Potential of carbon nanotubes for (can't read) computers and space elevators
- explanations of current sports problem and better understanding of muscle related – inhancers
- understanding of use of viruses to change genes' make-up
- genetic engineering is possible in humans
- obesity leads to disease; sugar-containing beverages is a cause; TV, computers is another cause; obesity death rates have gone up higher than tobacco
- corn, soy, cotton -- high % genetically engineered; I've probably already eaten them; cross-pollination a major issue
- Maps of coverage of different cell phone manufacturers; Clear explanation of how cell phones work; learned how to call overseas from cell phone (in response to question asked following presentation)
- That the superconducter actually repelled the magnet
- Towers are key to cell phone communication
- How it works; the terminology; I should switch my service provider!! Given the small area they serve
- How to pick a good camera; what factors to consider in purchase and use
- how important sleep is for processing
- sleep is a complex behavior, fascinating subject
- REM sleep improves our capacity to learn
- how active brain is in problem solving
- problems you can't solve should be left alone until after a good night's sleep
- Many facts about dreams but, more importantly, about how our brains function.
- That maybe, even from a moral standpoint, using animal parts is not different from eating them. I didn't know we already used valves. I'm nervous about the "fusion"

General Content

- Nano/cancer treatments
- Nano shells (? can't read), special interest (?)
- the science is ongoing
- Cancer research
- applications of nano-technology
- nanotechnology
- nanotubes
- (can't read) about nano-cells, (something, something) heat
- all of the stuff about how not to get fat
- BMI
- harm of soft drinks
- high glycemic vs. low glycemic
- fat
- How big its orbit is compared to other planets
- Sedna discovery; (2) Ort cloud
- cell towers
- E=mc2; gravity probe B (?); theory of relativity
- Time warps, gravity
- the temperature on Jupiter
- gyroscopes, Einstein's theory, news of Hubble
- shutter speed; memory issues

- The brain
- sleep states
- sleep is processing information
- brain processes info
- how the tubes form; (2) future uses
- Space elevator; brain damage?
- gravity, light, mass distortion, matter
- Pig organs an option of the future
- satellite; superconductivity and magnetic fields

General Content and Awareness/Realization

- technology is here!
- genetic engineering = good
- IGF could be a big problem
- new information; long-term implications
- how viruses are set up; handwashing tips

Scientific Process/Nature of Research

- NASA isn't wasting our money

Awareness/Realization

- No previous knowledge of the subject

Other/Unrelated

- The sound system needs repair -- Dan fixed it. Jim was cute
- None (3)
- The sound on the mike made certain consonants staticy
- Theory of new swim suits, etc.
- up-to-date and complete, quick data dump (?)
- I could not find any key points that should (be) taken away
- Our guide was a bit jumpy
- operation outside of service area
- both speaker and video were informative
- lack of organization
- Companies (....????....) the work on
- content could have been deeper
- good

Appendix 8: Visitor activities in CS&T (details)

The following are visitors' descriptions of their activities in CS&T (answers to the question: what did you do in CS&T?).

- Attend "Fats of Life" presentation
- [Presentation on gravity probe]. Was good, not too watered down. Not dumbed down; excellent on visuals; I liked the clip thing, the membrane table he demonstrated with, I liked the real model of spacetime and the multiple screens, I didn't know about this before. Question: how does this probe relate to my life? What's the point spending money on it? From a science perspective its useful, though not practical; the use may come later.
- AbiCor Heart, portable ultrasound: I worked on an ultrasound device in medial technology; unfortunately, the minimal invasive surgery exhibit is not working.
- A couple of displays, I never saw e-ink before, I came across it in a magazine (MIT tech review or Scientific American).
- I learned about carbon nanotubes and a lot of other things related to current and future technology.
- E-ink, I liked that the best.
- The heart exhibit, and the [amazingly shrinking] transistor presentation.
- "Heart; water filters, surgery tools, meteorites, TV screens, e-coli touchscreens (how to use e-coli to die denim). I liked the touchscreens but went to explore further. The artificial heart is fascinating, scary to have man-made thing in the body. Water filter is simple, that's what most people want, its so basic, a God-sent for people in developing countries."
- I knew about it, but not details. Still interesting to learn details of how they constructed the probe [gravity probe presentation].
- I like to explore things on my own, that's why I was not interested in the presentation. I looked at a few stories on touchscreens, saw the newsband.
- I looked at exhibits: surgical stapling, capsule camera, e-ink, water filters.
- The pill (capsule camera) and the [portable] ultrasound.
- The presentation was clear and entertaining; kids liked it; I liked the water filtration, the fact that ceramic is more effective and only costs one dollar, kids saw and liked medical technology.
- The presentation.
- The reader, water filtration, heart, MIS training box.
- I saw a few exhibits, then went to RISK [traveling exhibition on risk perception]; I liked best the surgical tools and demonstrations.
- I saw few exhibits, did some interactives, like the MIS training box (which was the best).
- I saw a presentation; the gravity probe and how it works, Einstein's theory, whether he was correct. The presenter told us about the process of research. Nice to have someone talk to you, you don't have to read an d he made it easy to understand something that I normally wouldn't understand.
- Simplicity of filter system; capsule camera and replacement heart were new technologies I didn't know about.
- Space module, mockup of cockpit [not part of CS&T, but adjacent], operating tools (they are amazing, how do people think about that?). The presentation just wrapped up, and they [kids] were more interested in the Indie Race car. I wanted to try the surgery interactive, but it was busy.
- Surgery tools: It's good knowledge to actually see tools and experience the hands-on; water filtration. Wife found information about nanotechnology on a touchscreen. The artificial heart: I liked the problem-solving approach. In general, the exhibition gives a broad sense on how science is trying to fix problems.

- Touchscreens: they were easy to read and use and they were fun. The kid went to the touchscreen and we followed the kid. The water filter was cool. The Gecko hands and toes that may lead to new adhesives; the general review of health issues; read about worms eating [illegible].
- Touchscreen: would have spent more time but the girls wanted to go; It was a good experience.
- I tried surgical tools. I liked the water filter; I lived in Africa, so I appreciated it. It's a simple and cheap water filter technology, compared to what's been done right now with iodine. I heard about e-ink on NPR. I liked the AbiCor heart and the miniature camera; I knew something about it, I may be using the camera for work.
- Ultra sound, the space touch screen
- Ultrasound, operating equipment, space stuff.
- I used the touchcreen, that was interesting. I used it for five minutes, read about experiments they conduct in Antarctica about the climate from the past. There were several other stories; I listened for a few minutes to a presentation, then went to screens and later looked at an exhibit on water filtration.
- I visited tech models.
- Water filtration, I read about it in the Boston Globe last year. A woman from MIT worked on it, I remembered that. The kids are playing, they enjoy it. It's interesting, it's happening, it provides little capsules of new ideas.
- Water treatment was fascinating; I looked at the touchscreen about the pyramid rover; and I didn't get how the Sonosite thing worked.
- Water filtration, reader, Sonosite, and "be a doctor" was neat.
- Water filtration and the pill [capsule camera] were interesting.
- The live presentation that grabbed the 12 year old. I it not ideal for the attention span of kids, unless it's interactive.
- I looked at everything: MIT water filter, ultrasound, capsule camera, artificial heart, and I remember a lot.
- I looked at exhibits; no touchscreens, no shows
- I tried watching a presentation, but my seven-year old son wouldn't stay, only sat for a minute.
- The kids were lost in it. It was more verbal, but it was interesting for us [adults].
- I looked at information on diabetes on the computer (I am diabetic); what they have been doing recently to treat it; that was very useful. I enjoyed doing this, it helps, I just happened to walk by when the screen was set on diabetes. We walked around and caught parts of two presentations in the afternoon. One was on SARS. I didn't stay, stood for only a few minutes.
- I learned about nanoscales; what's a nanometer? They drew a comparison with hair follicle.
- I saw part of a presentation on a missile launch, but my son was not interested so we went to RISK.
- Previously I looked at diseases, genetics, viruses, DNA; never saw a presentation, it was always too crowded.
- Touchscreens, various exhibits, but no presentations.
- Umpire machine in baseball presentation; artificial heart, video of missle launch.
- I walked around, my daughter stood on the CS&T spotlight. The girls went through some computer screens. I wanted to see a show at 9:30 AM, thought that this was the only one and that we missed it.
- I walked through it, but there was nothing interesting to make me stop; boys stopped at traffic computer
- Water filtration, Brita, MIT ceramics, Nigeria: would you want to drink the water there? Portable Ultrasound: picture of a gall bladder.