

**Evaluation Plan for *BioMedTech* Exhibition
at the Great Lakes Science Center**

March 23, 2006

Description of Exhibition to be Evaluated

BioMedTech is a 2,750 square foot exhibition at the Great Lakes Science Center (GLSC) that deals with issues related to biomedical technology. With a grant from NIH/SEPA, *BioMedTech* will be redone in order to update it. The new exhibition will be completely different although may include some of the same exhibit components. When completed, it will include approximately 10-15 stand-alone interactive exhibit units which will be a combination of computer interactives, AV presentations, and working simulations of various biomedical equipment. Next to the existing *BioMedTech* exhibition, there will be a small amount of space set aside as a Prototyping Area. This space will be used to let visitors know that the exhibition is being redone, and will also serve as a place to gather visitor comments, and showcase and test possible technology and exhibit ideas. Selinda Research Associates, Inc. (SRA) will serve as the evaluators for the redevelopment of the *BioMedTech* exhibition.

There are four main goals of the exhibition:

1. Introduce visitors to biomedical technology (BMT), i.e. the interdisciplinary application of physics, engineering, math and biology to medicine.
 - Provide the background information necessary to understand the field.
 - Show the impact of high-powered computation on the practice of medicine.
 - Show how doctors use physical phenomena to aid in diagnosis and treatment
 - Illustrate how advances in engineering, especially biomaterials and miniaturization, have improved medicine.
2. Show how BMT improves and saves lives.
 - Invite patients and doctors to tell their stories
 - Show how BMT has made diagnosis and treatment less intrusive and more effective.
 - Demonstrate its applications in medical imaging, genomics, global health and replacing diseased or injured organs and tissues.
3. Highlight CWRU's cutting-edge research and application of BMT.
 - Profile scientists working at CWRU and their research.
4. Introduce participants to careers in BMT.
 - Show how BMT improves and even saves lives.
 - Show the kinds of work available in the field.
 - Communicate the pre-requisites to working in BMT.
 - Let visitors "try out" selected aspects of working with BMT.

Type of Evaluation and The Research Question

This will be a front-end evaluation study. The research question will be:

What can we learn about potential visitors' understandings of and connections with biomedical technology issues that will help the exhibition team develop an engaging and provocative exhibition?

Project Team

It will be important to have a small **core evaluation team** that meets regularly throughout the project.

Katherine Ziff will serve as client for the evaluation study. She will participate in all meetings, provide all necessary information, review documents and provide feedback in a timely fashion, and serve as liaison between SRA and GLSC.

Val Davillier is PI and project manager for the SEPA project. He will participate in all meetings, provide input as appropriate, review documents, provide feedback in a timely fashion, and process payments.

Blake Andres is co-PI for the SEPA project, and will be a strong advocate for the visitor experience in this project. He will stay in touch with the work of the core team, and will participate in meetings whenever possible.

Deborah Perry will serve as project manager for the evaluation study. She will be responsible for keeping the evaluation project on time and within budget. She will also provide quality oversight for the evaluation project as a whole.

Eric Gyllenhaal will be the lead researcher for this study. He will be primarily responsible for developing the data collection protocols, collecting and analyzing the data, and writing up the final report.

SRA may bring on additional data collectors as necessary.

Communications & Relationship

The project will begin with a Kick-off meeting on March 13. We will then meet weekly via phone for the duration of the evaluation study. These meetings will take place on Tuesday afternoons at 2pm/1pm (eastern/central).

Selinda Research Associates is committed to a collaborative relationship with clients where expertise, information, and concerns are shared, and decisions are jointly made. Depending on the activity, the major responsibility for a particular task might rest with the client, project manager, lead researcher, or other members of the evaluation team.

Methodology

There is often confusion between research “methods” and “methodology” (Harding, 1987). In this study, we will refer to *methods* as the specific techniques used to collect data. These can include a range of strategies such as interviews, surveys, and observations, and are described below.

Methodology on the other hand, refers to the underlying structure or framework within which a study is conducted.

A methodology is a theory and analysis of how research does or should proceed; it includes accounts of how “the general structure of theory finds its application in particular scientific disciplines.” (Harding, 1987, p.3)

For this evaluation study, GLSC and SRA have agreed that we will use a naturalistic methodology (Lincoln & Guba, 1985). Naturalistic inquiry uses a rigorous and systematic approach for collecting and analyzing data in real-life settings, as opposed to setting up laboratory-style experiments in which particular hypotheses are tested. The goal of naturalistic methodology is to provide a holistic understanding of visitors’ experiences from a variety of perspectives.

Naturalistic inquiry is grounded in the belief that a situation or phenomenon may be experienced in different ways by different participants. Its aim is to examine the range of these experiences in order to more fully understand and articulate their meaning for participants. Naturalistic inquiry is based on the assumption that if we can understand our environment—or the particular phenomenon under investigation—in as complete a way as possible, we will be able to make better judgments about what applies in another situation.

Naturalistic Evaluation takes a broad, holistic view of the program, exhibit or institution being studied, is more interpretative than judgmental, and requires participation from a wide range of people who are to be served by the study effort.... Thus, Naturalistic Evaluation is directed toward a search for meaning.

And it is this search for meaning that distinguishes Naturalistic Evaluation from other field oriented evaluation strategies.... The purpose is to uncover the multiple realities and multiple perspectives that exist and are provoked as people experience the museum environment—it reveals the configuration of meaning that emerges when different people are exposed to a common stimulus. (Wolf & Tymitz, 1979, p. 2-3)

This qualitative approach to visitor research is particularly useful in museums because these institutions have diverse visitors with wide range of knowledge, experiences, and interests. Unlike quantitative methodologies, which tend to look for an “average” experience, naturalistic inquiry aims to describe the breadth of visitor experiences and understandings. As such, it is a powerful tool for museums, especially those institutions concerned with reaching multiple audiences.

Study Design

There will be four primary **phases** of data collection:

1. On-site observations of and interviews with casual museum visitors.
2. Review of existing written literature.
3. On-going collection of visitor comments in a comment book, or a talk-back wall.
4. Phone interviews with GLSC floor staff and with selected evaluators who have worked on exhibitions related to biomedical technology.

On-site Observations and Interviews: Eric will make an initial data collection site visit to observe and interview casual museum visitors as they engage with the existing *BioMedTech* exhibition. During this time he will also train Katherine in unobtrusive observation techniques so that additional data about visitor engagements can be collected after he leaves. After the data from these on-site observations and interviews are integrated with the data from the review of the literature and the

phone interviews (described below), a decision will be made about the usefulness and feasibility of a second site visit.

Review of Existing Written Literature: A brief review of the literature related to the public understanding of biomedical technology will be conducted to help the exhibit development team understand more fully how potential visitors think about these issues. Evaluations of other museum exhibitions on biomedical technology will also be examined. In addition to highlighting what we already know about how the public understands the focus of this exhibition, this review of the literature will also serve to triangulate the findings from the on-site observations and interviews.

Visitor Comment Cards: Throughout the front-end evaluation, there will be a visitor comment book, or alternatively a talk-back wall, that solicits open-ended comments from visitors in response to series of collaboratively developed questions. These comments will serve to illuminate how visitors think about and understand BMT, identify additional issues of importance, and triangulate other findings.

Phone Interviews with Museum Professionals: Selected GLSC staff members who have worked with visitors in the current *BioMedTech* exhibition will be interviewed to gain an additional perspective on visitors' experiences and how they understand and engage with the exhibition. In addition, museum professionals who have participated in evaluations of other exhibitions related to biomedical technology will be interviewed. These phone interviews will also serve to triangulate the findings from the on-site observations and interviews and the literature review.

Data Collection Methods

There will be five primary **methods** of data collection:

- ~ Review of existing documents
- ~ Unobtrusive observations
- ~ Depth interviews: face-to-face and by phone
- ~ Participant observations
- ~ Comment cards

Review of Existing Documents: This is described above.

Unobtrusive Observations: During unobtrusive observations natural visitor groups are watched and their behaviors recorded. Particular attention will be paid to four types of engagements: physical (e.g. watching, listening, pushing buttons), intellectual (e.g. thinking about the content and making connections), social (e.g. verbal exchanges, debate, body language), and emotional (e.g. awe, surprise, satisfaction, boredom, confusion).

Detailed notes about visitors' engagements will be taken, including observations about their apparent intellectual engagement, and social interactions to the extent possible. Although most observations will be conducted of visitors who naturally approach a particular exhibit unit, in certain situations, we may invite visitor groups to use a specific exhibit unit.

Depth Interviews: When possible, unobtrusive observations will be followed with depth interviews. After an observation is completed, the visitor group will be approached and asked if they would be willing to participate in an interview. If they agree, we will conduct the interview with as many of

the group members as possible. These interviews will focus on getting visitors to talk about their experiences at the exhibit, and to clarify many of the things we previously observed. The interviews will be open-ended and relatively unstructured, although an interview protocol will be developed to guide the conversation and ensure that important topics are covered. When possible, we will tape record and later transcribe the interviews. Visitors who participate in a depth interview will be given a small token of appreciation when the interview is completed. A similar process will be used for respondents who participate in a telephone interview. No tokens of appreciation will be necessary for phone interview respondents.

Participant Observations: In addition to the unobtrusive observations and depth interviews, we will also conduct some participant observations where (with a visitor's permission) we join an individual or group as they interact with an exhibit unit, and discuss with them what they are doing, thinking about, and experiencing. Participant observations tend to yield a richness of information that is not possible with the un-cued unobtrusive observations and depth interviews described above. However, they tend to take a longer period of time, and careful attention needs to be paid to make sure the data collector doesn't unnecessarily influence the visitor experience.

Comment Cards: These are described above.

Description of Respondents

The stated primary target audience for the *BioMedTech* exhibition is 4th-12th grade students, with a secondary audience described as "their families and teachers." Because most visitors to the museum are part of small casual social groups, GLSC and SRA have agreed that these small intact casual social groups will comprise the majority of the respondents for the on-site observations and interviews. While groups that contain children that appear to be within the target age range will be of particular interest, a group will not automatically be excluded just because it contains a member or members outside of that range. A conscientious effort will be made to study the experiences of visitors within the target age range.

Respondents for the phone interviews will be museum professionals who are likely to have a unique perspective on some aspect of visitors' experience with biomedical technology exhibits.

Selection of Respondents

In accordance with standards for rigorous naturalistic methodology, we will use a smaller sample size than one would find in many positivistic methodologies. While in some research paradigms this is cause for concern, it is one of naturalistic methodology's strengths. By studying fewer cases in more depth, we will develop a more complete and meaningful understanding of the visitor experience than would be possible by collecting less information from a larger number of respondents.

Although most people are more familiar with random sampling, in this study we will use a purposive sampling technique (Miles & Huberman, 1994). Purposive sampling is a technique where each respondent is selected based on the results of previous data sets. As data are gathered and preliminary analysis is conducted new questions and areas of interest emerge. Respondents are selected purposively to illuminate different types of visitor experiences around those questions and areas of interest. This ensures that we interview participants with a maximum range of experiences as they relate to the content of the exhibits. All respondents for this study will be purposively selected, except for comment card respondents who will be self-selected.

Data Analysis Methods

Data analysis for this study will be an on-going process using a modified inductive constant comparison approach (Lincoln & Guba, 1985). In an iterative process, this method takes each unit of data and systematically compares it to all previous units of data. As data are gathered on-site, preliminary understandings will be developed and tested out with respondents. After the interview and/or observation is completed, the researcher will sit down with a computer and engage in a more complete analysis, and will type up a formal debrief. The debrief includes a summary of the data collection session and records the researcher's interpretation of the session, comparing it to previously collected data. At the same time, the researcher also develops questions to be explored in subsequent data collection sessions, including any special areas of interest that should be explored. Data analysis will continue throughout the entire data collection process as well as during the writing of the final report.

Deliverables

The primary deliverable for this project will be a final written evaluation report. SRA will submit one bound hard copy and an electronic PDF copy.

Additional products will include: an evaluation plan and topical framework; 1-2 lists of design criteria (e.g. for supporting debate and dialogue, and for displaying current research); a brief review of the literature including a partial annotated bibliography; a half day of training in unobtrusive observation for Katherine; periodic verbal updates on preliminary findings.

Timeline

Planning	March 2006
~ Kick-off Meeting March 13.	
~ Develop evaluation plan.	
~ Develop topical framework.	
Data Collection & Analysis	March – May 2006
~ Review literature.	
~ Develop data collection instruments.	
~ Site visit to collect data and train Katherine, March 24-26. ¹	
~ Possible second site visit to collect data, May 5-7.	
~ On-going unobtrusive observations (conducted by Katherine).	
~ On-going data analysis.	
~ Periodic verbal updates on preliminary findings.	
Writing	May – July 2006
~ Write first draft of final report by June 15, 2006.	
~ Exhibit team reviews first draft and gives feedback to SRA by June 23, 2006. ²	
~ Write second draft.	

¹ The museum is open from 9:30-5:30 daily.

² The next Advisory Team meeting will likely be the week of June 19, 2006.

- ~ Second draft out for editorial review.
- ~ Write final draft.
- ~ Submit final draft by July 15, 2006.

Operating Budget

28 people days and \$3,000 in expenses

Topical Framework

The topical framework is a list of all the issues or topics we want to find out about during this study. This topical framework will be developed collaboratively by SRA and GLSC and will be in place before the initial data collection site visit.

Logistics

Eric and Katherine will work together on logistics such as:

- ~ Tokens of appreciation for respondents
- ~ A quiet place to type up debrief notes
- ~ Access to the museum and identification badges
- ~ Scheduling interviews with floor staff: Louise Palermo at 696-2760 is the contact person for this
- ~ The posting of signs informing visitors of evaluation (see below)

Ethical Treatment of Respondents

GLSC, SRA, and NIH are committed to the ethical treatment of respondents. We will adhere to standard professional practices for conducting research in settings of informal learning, and will ensure that the disruption of visitors' experiences is kept to a minimum. During all periods of data collection, we will post a sign informing visitors of the research and giving them a clear option for not participating. In addition, Eric, Deborah, and Katherine will all take the NIH on-line course about conducting research with human subjects as will any additional data collectors involved in the study.

Dissemination of Reports

The final report will be posted on the SRA website, as well as the GLSC website if possible. It will also be submitted to informal.science.org. GLSC will work to disseminate the findings as much as possible.

Project Closure

After the front-end evaluation study is over we will have a project closure meeting to reflect on the evaluation project and discuss lessons learned.

References Cited

- Harding, S. (Ed.). (1987). *Feminism & methodology*. Bloomington: Indiana University Press.
- Lincoln, Y. S., & Guba, E. G. (1985). *Naturalistic inquiry*. Newbury Park, CA: Sage Publications.
- Miles, M. B., & Huberman, A. M. (1994). *Qualitative data analysis: An expanded sourcebook* (2nd. ed.). Thousand Oaks, CA: Sage.
- Wolf, R. L., & Tymitz, B. L. (1979). *A preliminary guide for conducting naturalistic evaluation in studying museum environments* (Unpublished manuscript). Washington, DC: Office of Museum Programs, Smithsonian Institution.

**Topical Framework for the
Front-End Evaluation
of the Great Lakes Science Center
Biomedical Technology Exhibit**

**Selinda Research Associates, Inc.
March 23, 2006**

A topical framework is a list of issues or topics we will explore during the front-end evaluation. It is phrased as a series of questions we will try to answer by observing and talking with visitors and GLSC staff, and by reviewing the relevant literature. (Note: These are questions we will answer, not the questions we will ask visitors.)

Research Question

What can we learn about potential visitors' understandings of and connections with biomedical technology that will help the exhibition team develop an engaging and provocative exhibition?

Topical Framework Questions

5. In what ways do visitors' think and feel about biomedical technology (BMT), the application of physics, engineering, math and biology to medicine?
 - a. How do visitors understand and think about BMT? How do they feel about BMT? If they are unfamiliar with the term, how do they try to make sense of it? How interested are visitors in learning more about the subject, and why might some visitors not be interested (e.g., intimidated by subject, bad experiences with BMT procedures, uncomfortable in medical settings, etc.)? To what are visitors' interests driven by scientific curiosity, engineering challenges, "Grossology" aspects, and/or the personal or altruistic desire to improve and save lives (their own and others)?
 - b. What do visitors know and feel about the disciplines that contribute to advances in BMT, and about the interrelationships among those disciplines?
 - i. How do visitors think and feel, about the high-powered computers that are becoming so important to the practice of medicine? In what ways do young visitors relate BMT computing to their own interests in computers and related technologies?
 - ii. In what ways, and to what extent, do visitors appreciate and understand how doctors use physical phenomena to aid in diagnosis and treatment? How do visitors think and feel about the physical phenomena and the technologies that detect and display those phenomena?

- iii. How do visitors think and feel about the field of engineering and its relationships to medicine and biology? In what ways, and to what extent, do visitors appreciate and understand the ways that advances in engineering, especially biomaterials and miniaturization, have contributed to BMT?
 - iv. How do visitors think and feel about the field of genomics and its role in BMT, including pharmaceuticals? In what ways, and to what extent, do visitors appreciate and understand the ways that advances in our understanding of the human genome and ability to manipulate DNA are contributing to medical practice? In what ways, and to what extent, might visitors' lack of familiarity with (and perhaps their intimidation by) genetic terms and concepts interfere with their understanding and appreciation of the exhibits? What are ethically sensitive or potentially controversial topics in the minds of visitors?
- c. As the team further develops the content for the exhibition, what key concepts emerge that may serve as gateways or barriers to visitors' understanding and appreciation of the exhibits? Which of these concepts are visitors most aware of and most interested in, and why? How do they understand and think about key concepts that will be discussed, illustrated, and applied in the exhibits? Which concepts do visitors associate with ethically sensitive or potentially controversial topics or issues?
6. In what ways, and to what extent, do visitors appreciate and understand the impact that BMT has on patients' health, including saving lives?
- a. In what ways, and to what extent, do visitors appreciate and understand that BMT has made diagnosis and treatment less intrusive (i.e., surgery not required) and more effective? For those who have experienced one or more procedures, how do they feel about its intrusiveness and effectiveness? In what ways do these procedures seem ethically sensitive or potentially controversial to visitors?
 - b. On a more personal level, in what ways, and to what extent, do visitors appreciate and understand applications such as medical imaging, genomics, and replacing diseased or injured organs and tissues? Which of these topics are interesting to visitors, and what is the nature of their interest? Which of these topics do visitors find controversial or ethically challenging, and in what ways and to what extent might visitors be willing and interested in engaging in dialogue about these topics? What kinds of dialogues will resonate with visitors, and how should the team select topics for forum exhibits (see also 3.b., below)?
 - c. On a more global level, in what ways, and to what extent do visitors appreciate and understand that advances in BMT are being applied to detecting and treating infectious diseases globally? In what ways do visitors relate to these diseases, and to what extent are they interested in potential solutions for these problems? (This topic may include either perennial disease problems, like malaria, AIDS, and polio, or emerging diseases, like bird flu.)

7. What can we learn about effective ways to present BMT in a science center setting?
- a. What are effective ways to present controversial topics in an exhibit about BMT? What can we learn from the experiences of other science centers that have presented controversial topics, especially those that have developed forum exhibits where groups of visitors engage in dialogue?
 - b. In what ways do visitors want to relate to others within their social groups—and, for that matter, within other social groups? To what extent would they be interested in sharing stories, discussing ethical issues, or engaging in debate? How would they respond to being offered a structure to shape their discussions (such as being given roles to play)? What exhibit options have been tested at other institutions, and what has been learned from these earlier exhibits? (The options might range from informal face-to-face conversations and discussions to a range of technologically mediated dialogues where, for instance, individuals respond directly to the exhibit, read and respond asynchronously to other peoples' responses, and so forth.) What can we learn by watching and talking with visitors as they use the visitor-response exhibit in the BMT prototype area?
 - c. In what ways can telling the stories of actual patients advance the goals of the Biomedical Technology project? What issues might the team face in developing and exhibiting these stories? For example, do we risk being perceived as judging people based on their health status? In what ways can the team gain insight into these issues (e.g., individuals and organizations as advisors, visitor panels of medically challenged individuals, the published literature).
 - d. In what ways, and to what extent, might project goals be advanced by profiling individual CWRU doctors, researchers, and engineers? What challenges will GLSC face in developing and maintaining exhibits about particular doctors, researchers, and engineers?
 - e. In what ways would simulated medical settings (e.g., an operating room) and procedures (e.g., endoscopy) contribute to visitors' understandings of BMT and thus influence the effectiveness of the exhibits? What has been the experience of other science centers with these types of exhibits? How can GLSC balance the pros and cons of these exhibits, minimizing discomfort of some visitors while stimulating and satisfying the curiosity of others?
 - f. What is the range of visitors' reactions to real medical equipment, prosthetics, and graphic medical images? How might visitors' reactions influence the effectiveness of the exhibits? What has been the experience of other science centers, and how can GLSC balance the pros and cons of these exhibits?
 - g. In what ways do visitors respond to mechanical interactives that metaphorically model applications of BMT (for example, a pulley system that embodies the

- principles that make tendon transfer work)? To what extent do visitors attend to and use the examples in the current exhibit, and do they think about these interactives in ways that help advance their understanding of the “real thing”?
- h. How do visitors respond to AV and computers as modes of communication for biomedical techniques and procedures? Do some topics seem better suited to this approach? When looking at images, do visitors respond differently to real footage vs. simulations? What has been the experience of other science centers using alternative physical user interfaces (beyond trackballs and buttons)?
8. In what ways and to what extent are visitors aware of, and interested in, research & development of new BMT applications (as opposed to basic research in the individual disciplines)?
- a. In what ways, and to what extent, do visitors appreciate and understand the interdisciplinary development of new BMT applications? What do they know and feel about the disciplines that contribute to BMT research & development, and the ways in which BMT research & development is done?
 - b. Which aspects of current BMT research & development do visitors find most compelling? How current does a presentation have to be to seem “up-to-date” or “cutting edge” to visitors? To what extent do visitors want and expect GLSC to be a place-to-go for current biomedical research & development? What challenges will GLSC face in developing and maintaining exhibits about current research & development?
 - c. To what extent are visitors aware of and interested in the places where BMT research & development is done? To what extent are visitors aware of Case Western Reserve University (CWRU) and its role in BMT research & development? In what ways might the BMT project challenge and expand visitors’ existing understandings of CWRU and the roles of universities in BMT research & development?
9. To what extent are young visitors (and their parents, guardians, and teachers) aware of and interested in potential careers in BMT?
- a. To what extent, and in what ways, do young people think about their own future employment opportunities in the field of BMT? What aspects of BMT appeal the young visitors? To what extent is their interests driven by scientific curiosity, engineering challenges, salary considerations, and/or altruistic desire to improve and save lives?
 - b. To what extent are young visitors aware of and interested in the kinds of work currently available in the BMT field? What types of jobs do they find most interesting, and why? What BMT jobs might they be interested in “trying out,” and what sort of employment simulation would be most appealing to them?

- c. To what extent are young visitors (and their adults) aware of, and interested in, the interdisciplinary nature of BMT careers? How does their awareness of interdisciplinary links influence their interest in a BMT career?
- d. In what ways, and to what extent, are young visitors (and their adults) aware of and interested in learning about the pre-requisites to working in BMT? How might these pre-requisites be related to visitors' current interest in and knowledge and feelings about higher education?