Mystery Lab Evaluation

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Final Report

Serrell & Associates

February 1996

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Introduction

This report summarizes the processes and findings of a two-year, multimethod evaluation of the Museum of Science and Industry's *Mystery at the Museum* program.

As part of the "Imaging: The Tools of Science" exhibition that opened in 1993, *Mystery at the Museum* is a comprehensive program for regional schools designed for 5th-through-8th-grade science classes. The Mystery Lab occupies a separate room in the exhibition for use by school classes in the morning and the visiting public in the afternoon. (See Figure 1.) No evaluation of the public's use of the Mystery Lab was done as part of this evaluation project.

Before teachers bring their students to the Museum for their one-hour "lab" experience, they are required to participate in a one-day teacher-training workshop to acquaint them with the program's objectives, activities and materials provided to help students prepare for and follow up on the in-museum part of the program. At the workshop, teachers are given a guide, a resource kit, an abbreviated version of the lab experience and activities, and an opportunity to sign up for the program.

Evaluation of *Mystery at the Museum* was started in February 1994 with two main purposes in mind: 1) to assess program's impact on teachers and students, and 2) to guide improvements to all aspects of the program.

The evaluation plan consisted of eight main steps, ranging from preliminary observations of the Mystery Lab program, to critical reviews of all its parts, to the development of specific new methodologies to capture and compare the impacts of the program on the teachers and the students. (See Appendix 1 for the time line and outline of the plan.) During the first steps, the emphasis was on gathering data for the purposes of review and remediation. During the latter steps, the emphasis was on documentation of impact and outcomes.

The plan and the various evaluation instruments used were developed jointly by Serrell & Associates and the Museum of Science and Industry (MSI) in an iterative process to achieve thorough and useful data. After reviewing data at each step, MSI adjusted program material (delivery method and content) and can continue to use evaluation instruments developed during this project to collect additional data.

Step One: Alignment of the Mystery Lab Program with Benchmarks

Project 2061: Benchmarks for Science Literacy is an educational curriculum reform initiative by the American Association for the Advancement of Science. It sets the criteria for what all students should know or be able to do in science, mathematics and technology by the end of grades 2, 5, 8 and 12.

The Mystery Lab program was developed before Benchmarks was available. MSI initially avoided restricting the program's goals to specific cognitive gains, instead opting to focus on broader, more generalizable information. But when Serrell & Associates and Mystery Lab developers noted the close match with seven of Benchmarks' conceptual statements and Mystery Lab's content, they decided to apply them to the lab to give it a more clearly defined science literacy focus.

These are the seven Benchmarks teaching points integrated into the lab: (1) tools of science; (2) newer technologies; (3) observation skills; (4) variety of evidence;

(5) teamwork; (6) independent thinking; and (7) broadened awareness of science-related careers. Each is intertwined in the students' Mystery Lab experience--working with new and old imaging technologies; looking at a variety of evidence to solve a mystery; working in teams in a cooperative environment; and imitating the skills and training of forensic scientists.

The integration of Benchmarks' science literacy goals with the Mystery Lab program helped to focus the evaluation efforts and provided guidelines for making specific improvements to the program.

Step Two: Pre- and Post-visit Questionnaires

To demonstrate an educational program's impact, a typical evaluation method is to compare pre- and post-visit measurements of the participants' knowledge, skills and attitudes and note the differences between the two scores.

Preliminary versions of an instrument containing open-ended and multiple-choice questions to test for knowledge and meaningfulness of the information to the Mystery Lab learners were administered to a small sample of both teachers and students. (See Appendixes 2A and 2B.)

This instrument did not prove to be sensitive or well-matched to the teachers' and students' brief, one-time, episodic museum program experience. As a paper-and-pencil test, it was too verbally specific compared to the more narrative and experiential context of the Mystery Lab. The written vocabulary proved difficult for the students. For example, "MR scan" was misread as "mister scan," and students could not remember (from word cues alone) the difference between optical and scanning electron microscopes. After preliminary testing it was decided to discontinue using the instrument in that form and to seek a more authentic and responsive method of measuring participant outcomes.

Step Three: Critical Reviews

Ordinarily, a critical review would have been the starting point of the evaluation strategies, followed by other methods. The questionnaires described above were administered first, however, due to the school-year schedule and easy availability of both teachers and students.

Serrell & Associates conducted and documented for MSI three critical reviews of the Teacher Workshops (report dated October 1994), the Teacher's Guide and Kit (report dated August 1994) and Student Program (report dated November 1994). Each review made specific suggestions intended to improve the emphasis on Benchmarks and the effectiveness of the materials and program scripts.

Recommendations in the reviews ranged from attention to logistics ("Can participants find workshop sites?") and participant comfort ("The rooms are too cold."), to maximizing content impact ("Shorten the workshop and clearly state the main points."). Evaluators noted some gender bias in the way student participants were called on during the student program and also some outdated or incorrect concepts and words (race, Caucasian) that are presented as facts in lab materials and videos.

MSI responded to these reviews by implementing many changes. Museum staff made adjustments to the workbooks, classroom kits, student program materials and script, and created some new materials (e.g., agendas for the teacher workshops). Additionally, the lab worksheets were redesigned to make them more visual, easier to read and concretely connected to the Mystery Lab experience.

Step Four: Open-ended Interviews

In May 1994, Serrell & Associates used a more naturalistic evaluation method to assess immediate impact of the student program by conducting open-ended interviews with 30 5th- and 7th-grade students after they had participated in the Mystery Lab. The students were chosen randomly and interviewed one at a time. After a couple of warm-up questions ("Is this your first visit to MSI?" "Do you have any special interest in science?"), students were asked, "If you were to describe to a friend what just happened in the Mystery Lab, what would you say?" The evaluator probed with open-ended questions that followed a student's line of thinking (e.g., "And then what happened after you ___ ?"). These interviews were taped and transcribed, and museum staff met with Serrell & Associates to discuss the findings.

The interviews provided evidence that students were grasping specific and sometimes generalizable science content from the program. For example, students said they "compared things" and "learned to take down clues." Although this method yielded some valuable information, it seemed to emphasize answers that were related to details of the Mystery Lab experience, such as how much the lottery ticket was worth and the victim's name and, thus, did not provide as much data related to the Benchmarks' science literacy goals as we desired.

It was decided that the Mystery Lab program leaders would more strongly emphasize how specific workshop content and tools related to the larger generalities of science. Some further adjustments were made to the program script and materials to facilitate this emphasis, as well as to address some Benchmarks goals that students had not manifested in this evaluation (e.g., teamwork, independent thinking).

By the end of the first year of evaluation, in February 1995, many of the remedial changes indicated by our early evaluation efforts had been made, and we were ready to embark on more summative evaluation in our efforts to document impact and outcomes.

Step Five: Open-ended Questionnaires

Because the pre-/post-visit test design was too specific for participants to deal with, and the open-ended interviews were too unfocused on program goals for the staff's satisfaction, another strategy was sought. We wanted to overcome these problems and also deal with the difficulties of administering tests immediately after participation in the program--when the students' schedule demanded that they move on to lunch, the Omnimax presentation, or return to their school busses.

After discussing the various options, it was decided to administer a modified version of an open-ended questionnaire that Serrell & Associates had previously used successfully to gather feedback from adult museum visitors about exhibitions. The questioning format did not rely on respondents to possess any specific verbal (vocabulary) skills, yet it could be goal-related to the program. (See Appendixes 3A and 3B.) To allow students ample time to fill out the questionnaires thoughtfully, we decided to visit their schools instead of using their museum time to do it. The nature of the questions also meant that a pre-/post-test design was not appropriate or necessary since the questions could only be responded to by someone who had participated in the program.

This is so great!

After some preliminary testing of the questionnaire with students, the first two questions were revised from "What did you do?" and "What did you find out?" to two fill-in-the-blanks: "It was to teach us about..." and "It was to give us experience with...". This change encouraged students to describe the meaning of their experiences more generally (e.g., "We listened to people talk about evidence."), as opposed to giving specific mechanical details (e.g., "We watched a video.").

Beginning in January 1995, Serrell & Associates visited eight public and private schools in the Chicago area and administered questionnaires to 69 students who had recently attended a Mystery Lab program. The time between lab visit and questionnaire administration ranged from two to three weeks.

The students who completed questionnaires were a diverse group, ranging from those representing gifted classes to learning disabled 5th- to 8th-graders. Students were not prepared or coached in any special way by their teachers prior to being given the questionnaires, although the learning-disabled group had the questions read aloud and were given some assistance in writing their answers. The results were transcribed and coded to note points where students restated or paraphrased one of the seven goals from Benchmarks. (See Appendix 3C.)

The open-ended questionnaire results provided evidence that students could recall specifics of the program and also make some generalizations about lab content. For example, it revealed that students related the events of the Mystery Lab to current events (O.J. Simpson trial) and their own lives ("...reminded me of my dead dog."). Students comprehended the ideas of low- and high-tech tools, specific technologies (fingerprinting, face-aging, MRI), and examining several kinds of evidence ("clues"). They also recalled facts related to the "mystery" ("I didn't know Lotto tickets were good for a year."). Less frequently, they addressed the need to think independently and work in a team. The number of specific comments outnumbered general or unrelated ones. The number of positive general comments (e.g., "fun," "interesting") outnumbered the negative or critical ones (e.g., "boring," "should let everyone do all the activities").

A content analysis of responses (word searches) revealed that 64% of the students mentioned all three concepts: solving a mystery or problem, using "modern" or low/high technology, and mentioning a specific form of technology such as fingerprinting and face-aging. Serrell & Associates considers this level of response from children several weeks after a one-time museum program to be positive and significant.

Serrell & Associates noted that Benchmarks points appeared to be evenly distributed across student-group transcripts, indicating that the Mystery Lab works well for a diverse population, and the open-ended questionnaire instrument worked well with students of both high and low verbal skills.

Step Six: Experiential, Authentic Evaluation Design

After the open-ended questionnaires, which demonstrated impacts on students who participated in the program, we still desired to show outcomes in an evaluation design that used treatment versus nontreatment groups. But we did not want to use an instrument that measured what students learned in a way that was radically different from how they learned it. The solution seemed to lie in using a problem-solving evaluation situation to measure the impact of the problem-solving activity of the Mystery Lab.

We decided to invent a new problem/scenario and compare the mystery-solving ability of students who had experienced the Mystery Lab with a control group that had not. To this end, MSI's Mystery Lab developer created a new mystery (see Appendix 4), and more in-school follow-up visits were scheduled.

Serrell & Associates visited eight schools in Chicago where classes had participated in the lab program in the last six to eight weeks. At each school evaluators read the new mystery and showed prop photos to two groups of five students--one group that had the lab experience and one "no-lab" group. The new mystery had some similarities to the original mystery used in the Mystery Lab (fiber evidence, an injured suspect who could be examined with MRI, a suspect with only one youthful photo, opportunities for face-aging, etc.; see Appendix 4). Following the reading, students were asked how they thought the mystery could be solved and what tools or procedures might be used to solve it. The ensuing discussions were tape-recorded and later transcribed to hard copy for analysis.

Facilities at the schools were disparate, making uniform taping on-site difficult. Some schools were able to provide evaluators with quiet, private spaces; others only could offer busy hallways due to lack of space. Still, all students involved seemed to enjoy solving the mystery. Some group discussions were difficult to conclude because students were so animated in their responses.

Content analysis of the transcripts suggested that students who had attended the Mystery Lab could name and describe specific ways to decipher evidence. For example, one student said "...they could like take a fingerprint from all the suspects..." and went on to describe in detail the fingerprinting process. Students who had not attended the lab also were not at a loss to name many real and imagined things they thought could help solve the mystery. One group that had not attended the lab suggested these ideas: machines to test for bad luck, passing out flyers, getting a warrant, sending notes to the suspect's neighborhood, looking at the security video, staking someone out, or noting a "sneaky smile." One student in a no-lab group was so excited by what he felt was visual evidence in the prop photos that he insisted evaluators wait while he retrieved his magnifying glass from the classroom to help examine the pictures.

Both groups used a variety of words connected with the process of and the tools used for analyzing the new mystery. A comparison of the two groups for the frequency of the students' use of key words that related to using high-tech forensic science tools to solve the crime showed that the most commonly used term, used equally by both groups, was "fingerprints." (This was also the most common term in the other interview and questionnaire evaluations.) In addition, we found that the students in the lab groups used the appropriate key words twice as often as the no-lab groups, and used less appropriate words (low-tech and/or unrelated) half as often as the no-lab groups.

In the chart below, the high-tech tools related to the Mystery Lab program are shown in bold:

	Lab group used more	No-lab group used more
Appropriate words	Compare, match, evidence, observe/observation, test, investigate	Collect, question, discover/detect, find/figure out
	Equipment/machine/computer, **face-aging**, DNA, blood, **x-ray/MR**, and **microscope/SEM**	Hair/fiber/cloth
Less appropriate words	Lie detector tests	Footprint, video camera, magnifying glass, virtual reality

A few examples from both groups indicated that some naive ideas students bring with them are durable and perhaps not challenged enough by the lab experience to be changed. For instance, a student who had attended the Mystery Lab said that she could tell which suspect was guilty "because [of] the way his face is looking. I can tell who is guilty or who is not guilty, and I can see that his face is guilty."

Step Seven: Staff Discussion and Reflection

Serrell & Associates gathered information from nearly all of the staff who have worked over the past two years on the Mystery Lab student programs, teacher workshops and materials. At an informal meeting, these individuals expressed satisfaction with the lab and enthusiastically approved of the fine-tuning of its content and impact achieved through this evaluative process.

The staff noted a few things they would have done differently, if they were going to do it over again. Some felt that a shorter video would have allowed more time for discussion. Others thought that not using the lottery as a scenario would have kept students from becoming overly focused on the monetary goal rather than the forensic scientific one. A computer element for the MRI component would make that activity more in balance with the others and would make sure that all four activities took equal times. More reinforcement of verbal/visual experiences with actual-use experiences was also suggested.

Overall, developers, implementers and evaluators alike believed that Mystery Lab was a worthwhile, valuable endeavor and were proud to be part of it.

Step Eight: Teacher Evaluations

In July 1995, the Museum of Science and Industry mailed questionnaires to 245 teachers who were Mystery Lab participants to assess their use of the Mystery Lab preparation activities and materials and the resulting impact. The teacher questionnaire was in two parts: Part A asked questions about the Workshop, and Part B focused on the Teacher's Guide and Kit. (See Appendix 5.) Ninety-two (92) were returned (a 37% return rate).

The first question asked how participants learned of the workshop. More teachers heard about the workshop through "word of mouth" (43%) than any other means. The next largest groups heard about it from a Mystery Lab brochure (37%) or *The Notebook*, a publication of MSI's education department (30%). Fewer mentioned a teacher in-service, teacher fair, or the newspaper as a source.

The Mystery Lab program is targeted for, but not restricted to, 5th- through 8th-grade science teachers. Seventy-four percent of the teachers who responded to the questionnaire said that they had special interest, knowledge, or training in science, and the most common field of study mentioned was biology.

The teacher workshop typically lasts about 4 1/2 hours. The vast majority of teachers (85%) felt that the length of the workshop was "just right." The remainder were divided almost equally in considering it too long or too short. Rating how well the workshop prepared them to conduct the classroom activities and bring their students to the museum program, 74% indicated that they were "very much" prepared, 25% said "somewhat" and one person said "a little." During the workshop teachers are encouraged to ask questions. All but one of the teachers felt their questions were answered.

Teachers were asked to give their suggestions for improvements to the workshop. The most common suggestions were: to include more background information with the activities; to provide ideas for older or more advanced students; and to have smaller workshops (typically attendance is about 30 to 40 teachers). Among the suggestions for improvements, one teacher offered this useful idea to presenters: "Introduce the lessons as you would to students," indicating that modeling the way to present these sometimes complex lessons would be helpful to even seasoned teachers.

The Teacher's Guide is divided into four sections that reflect the activities in the Mystery Lab: microscopy, fingerprinting, face-aging and X-ray/MR. Each section had one or two recommended activities that teachers are to do with their students prior to bringing them to Mystery Lab, and these are the activities that most teachers indicated they used. More than 80% said they did the fingerprints, hairs and X-rays. Roughly 65% used the face-aging activities. Among the least used were: memory game, coins, face and clock, magnetic fields and sickle cell. One teacher mentioned that they "had trouble with the face-aging." Another said they "modified" the coffee mug activity "to make it easier." Several mentioned that they "loved [the activities]" or "used them all." A majority of teachers felt that the class materials prepared their students well for the lab. Positive comments included, "I was pleased with the entire program, please continue your super job!" and "Very helpful for a non-science teacher."

All of the activities for the Mystery Lab program focus on biomedical and forensic imaging, and for many teachers (43%), this may be the only human biology units taught in their classrooms. Of the 56% who said they did teach other human biology units, about half of them dealt with human systems (e.g., endocrine system, reproductive system, immune system).

When asked if they assessed results of the lab experience with their students, a majority (59%) said yes. They listed a wide variety of assessment techniques including: a quiz, practical and written tests, presentations by students to explain and demonstrate to others, and worksheets, reports and project folders (portfolios). Many of the assessment techniques used open-ended methods.

As with the teacher workshop, teachers also were asked for their suggestions on ways to improve the Teacher's Guide and Kit. Suggestions included: more background information on student activities; longer lessons; time line for activities; assessment techniques; career information; and a version of the workbook in Spanish. Suggestions for the kit were: inclusion of microscopes and more slides; a longer loan period; and the ability to purchase kits.

One recent measure of the success of the Teacher Workshops is repeat attendance. The Museum has developed a refresher workshop to meet this on-going demand.

Summary

During the Mystery Lab evaluation process, Serrell & Associates used several different instruments and activities that elicited different kinds of information in different ways. Throughout the process, instruments were fine-tuned to enhance their information-gathering capacities. Additionally, Mystery Lab staff were consulted at many points in the evaluation process, and their experiences and advice also shaped the evaluation. The process of searching for and finding authentic ways to evaluate the program were as interesting in some ways as the findings themselves.

- During step one, as we aligned the Mystery Lab goals in a broader way that would reflect and encompass some of the goals of science literacy as described in the AAAS Benchmarks initiative, we felt empowered to be part of a national educational effort.

- Although we suspected that the traditional tool of a paper-and-pencil pre- and post-visit test would be difficult to develop and administer in a museum, step two taught us that indeed it is not the most sensitive measurement tool to use with an untraditional program with its diverse and time-limited audience.

- The critical reviews of step three resulted in the Museum making numerous beneficial changes in the program prior to the final steps of the summative evaluation. By taking these remedial steps, MSI assured that the program benefited from the results of some of the evaluation before testing for impacts.

- Responding to trends in the field of evaluation to use more naturalistic and authentic measurements of student learning, steps four, five and six experimented with a variety of ways to accomplish this. While we found that students can easily recount and describe their activities and impressions during individual open-ended, tape-recorded interviews and problem-solving group discussions, these methods of collecting data were, by comparison, more labor-intensive, less focused and more difficult to analyze than the brief written questionnaire.

- Teacher evaluations confirmed that teachers used and benefited from the workshops, guide and kit. Their suggestions and comments were incorporated into revisions to the materials and changes that benefited the program in general.

- Self-evaluation through staff discussions revealed a sense of pride and satisfaction with the program, as well as critical awareness of Mystery Lab's weaknesses.

Museum programs like the Mystery Lab provide participants with the kind of direct and focused experience that informal museum visits rarely achieve. Still, they have limitations, and it is important to remember that when evaluating for impact, we must be inclusive and sensitive, and then lenient in our interpretation. While we may not ask participants in a one-time program to show an 85% concept mastery rate as might be expected from a semester-long, sequential classroom experience, we believe that the fact that 64% of the Mystery Lab participants mentioned all three aspects we were evaluating for (solving a problem, using tools, mentioning one specific imaging technology) indicates successful impact of the program.

To date, no tested and accepted standard of achievement exists for this kind of museum program, so in a sense we are evaluating in a vacuum of similar experience. But we think our process and products are a worthy model. Both the teachers' and students' enthusiastic responses to the form and content of the Mystery Lab are reflective of its relevance and success.

Finally, it is important to note that although the Museum of Science and Industry is a large and well-funded institution, the kinds of evaluations and changes the Museum committed to were mainly low-tech and low-cost. While the scope of this project may not be replicated by museums with lower budgets, the process can be duplicated without a large budget. Smaller museums should not hesitate to appropriate and adapt any of these tools and methods for their use. (The instruments developed during the course of the evaluation process were presented by evaluator Beverly Serrell at a recent "Learning in Museums" seminar in Chicago, where they were reviewed positively by professionals in the field.)

Serrell & Associates recommends the process of evaluating formatively and using open-ended instruments and authentic, experiential discussions for summative evaluation. The low-tech tools used here, such as critical reviews, open-ended questionnaires and staff input, are methods that can and should be more widely used by museums of any size in the process of evaluating and improving their exhibits and programs.

Appendix

1). Time line for Mystery Lab Evaluation at MSI

2). Pre-and-post-visit Questionnaires

2A. Draft 2 Student

2B. Teacher

3). Open-ended Questionnaires

3A. First version

3B. Final version

3C. Data codes

4). New Mystery for Authentic Evaluation

5). Teacher Evaluations

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opened Sept 93

IMAGING: The Tools of Science

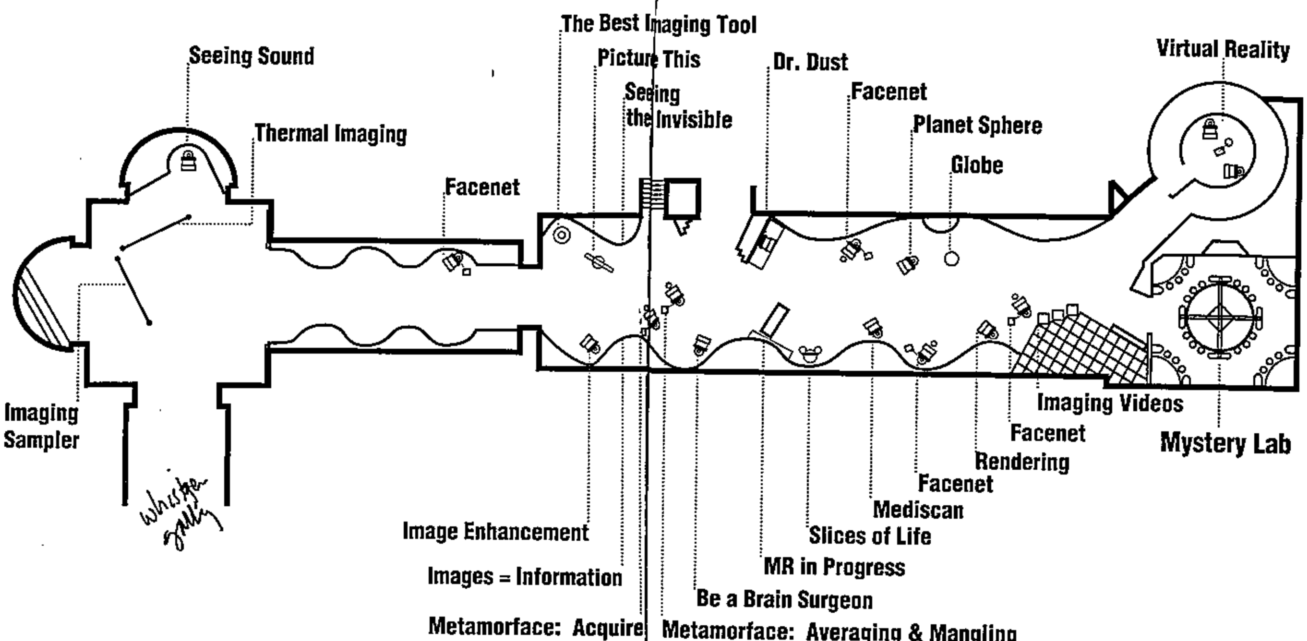

Exhibit Map

Figure 1.

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Slices of Life—
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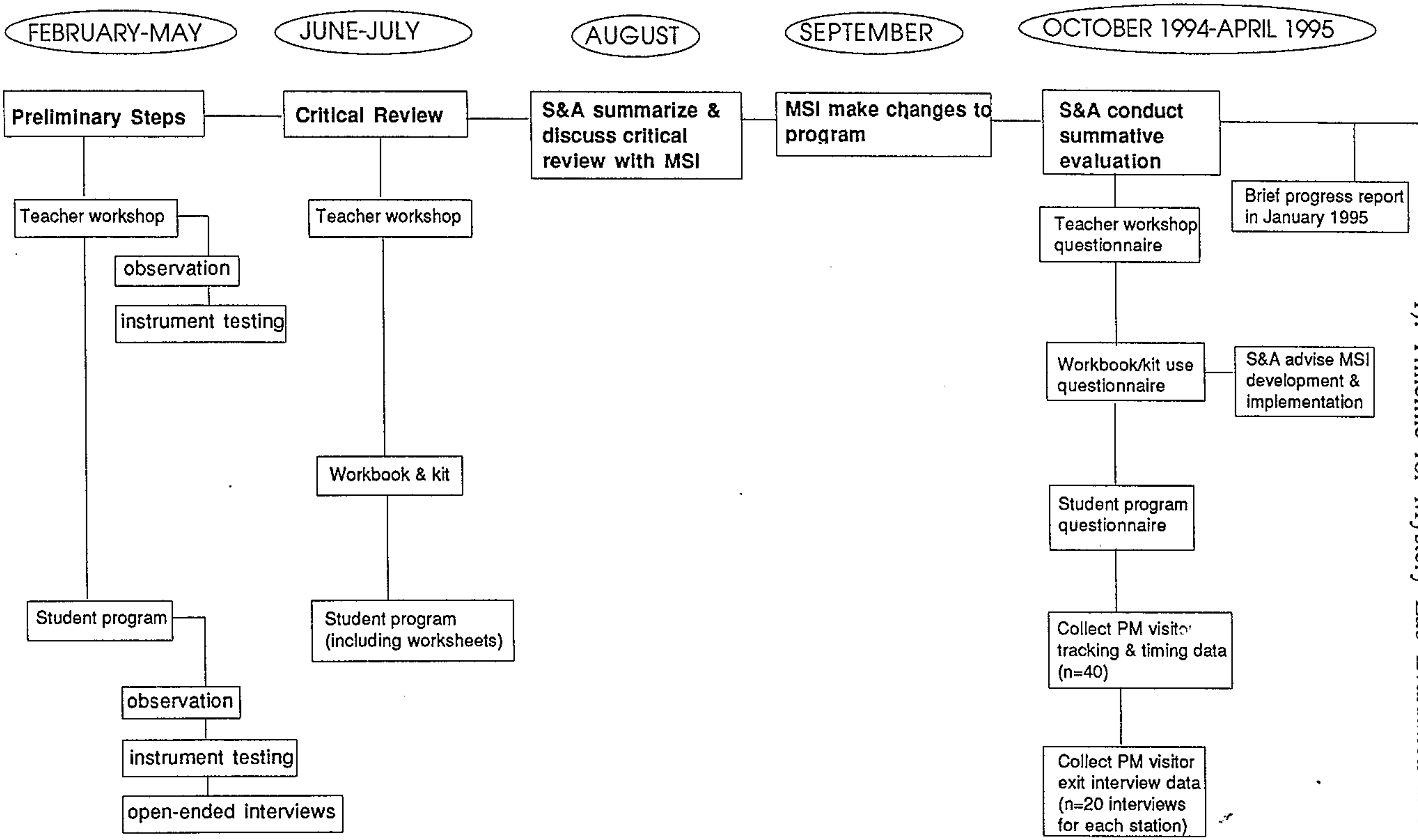
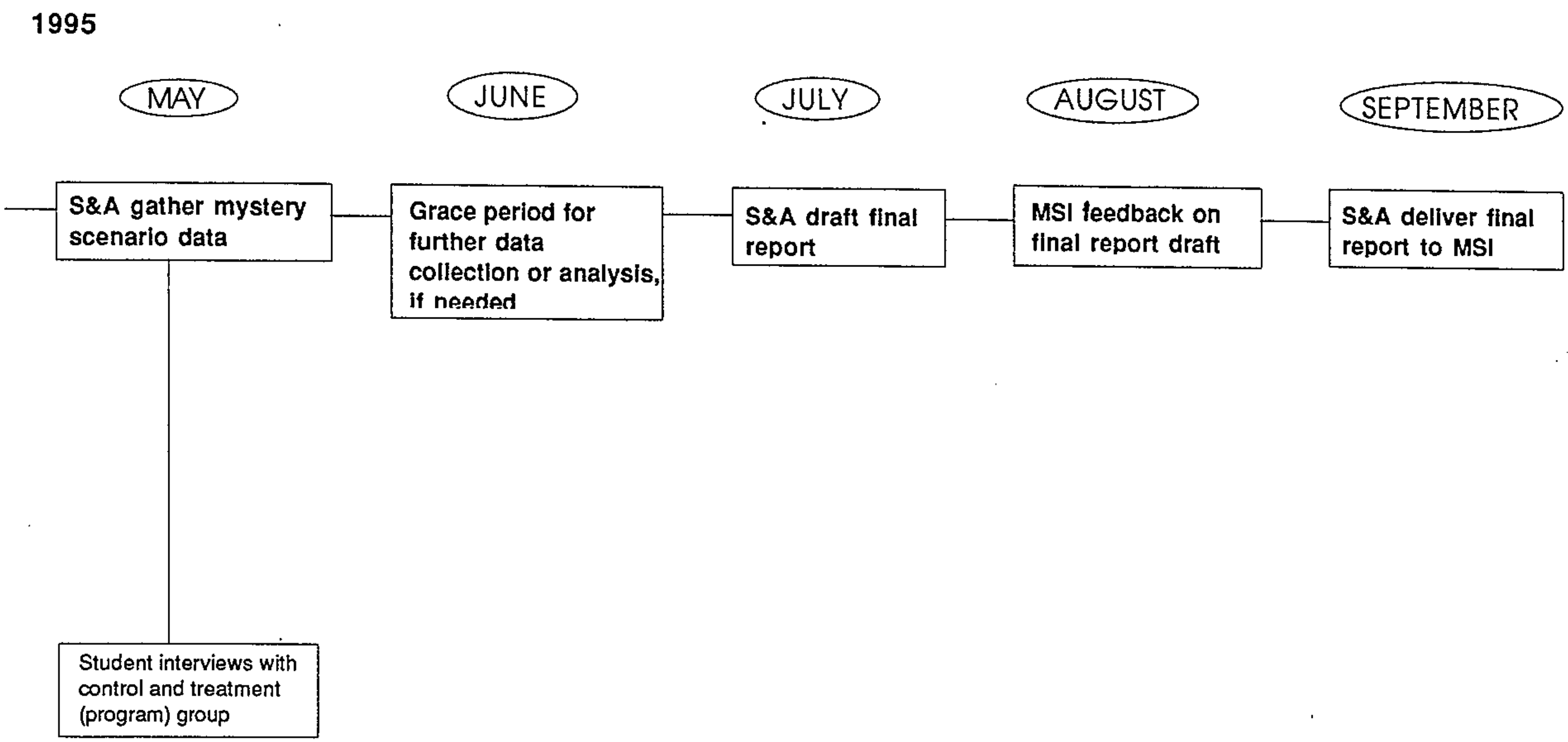
1). Timeline for Mystery Lab Evaluation at MSI

Timeline for Mystery Lab Evaluation at MSI
Serrell & Associates
13 June 1994

1994




1995
MAY
JUNE
JULY
AUGUST
SEPTEMBER
S&A gather mystery scenario data
Grace period for further data collection or analysis, if needed
S&A draft final report
MSI feedback on final report draft
S&A deliver final report to MSI
Student interviews with control and treatment (program) group

2A. Draft 2 Student

Pre/Post

Museum of Science and Industry
Mystery Lab Student Program
(Draft 2)

Date ___________

Background Information

1. Teacher ________________ Age _____ Are you Male or Female

2. Is this your first visit to the Museum of Science & Industry? Yes No

3. Do you have any special interest in science?

No ___ Yes (explain)_____________________________________

....

Questions related to "Mystery at the Museum" Program

1. Scientists have a variety of "tools" that use computer technology. These tools help scientists image parts of the human body that cannot be seen with the naked eye. Circle which of the imaging tools below use computer technology.

microscopes that use light	x-rays that use film
microscopes that use scanning electrons	calipers
35 mm camera	MR scan

2. Computer technology has helped scientists make images of the human body in new ways. **Give one example of a computer-based imaging tool and what it can do.**

____

____

(turn to the other side please)

(fill in the blanks)

3. What 2 or 3 words come to mind when you hear the word SCIENCE?

_ _

4. What 2 or 3 words come to mind when you hear the word EXPERIMENT?

_ _

5. What 2 or 3 words come to mind when you hear the word HYPOTHESIS?

_ _

6. When scientists use a variety of tools to collect different kinds of evidence, they can make a more complete story which helps them be more accurate in solving a problem. (circle one)

agree strongly	agree	don't know or not sure	disagree	strongly disagree

7. When scientists work together, sharing their findings and sharing ways of looking, it can lead to more accuracy and confidence in the conclusions. (circle one)

agree strongly	agree	don't know or not sure	disagree	strongly disagree

8. Even when scientists work together as a team, the members of the team must still think independently and reach their own conclusions. (circle one)

agree strongly	agree	don't know or not sure	disagree	strongly disagree

****

Any other comments?

Thank you for taking the time to fill this out. Please give it to the Mystery Lab program leader.

2B. Teacher

Pre-only
~~Post-only~~
Pre & Post

Museum of Science and Industry
Mystery Lab Teacher Workshop

This is an experimental questionnaire--if you don't understand a question or know the answer, say so--It will help us develop a better questionnarie for the future. Thank you for your help.

Name ______________________ Date ____________

1. What grade students do you plan to bring to the Mystery Lab? ______

2. How did you hear about the workshop?

____

3. In what ways does the Mystery Lab program fit into your curriculum?

____

4. Do you have any special interest, knowledge or training in science?

No ___ Yes ___________________________________

....

1. These "tools" are used by scientists to image the human body or parts of it. Which ones incorporate computer technology?

magnifiers	optical microscopes
drawings	scanning electron microscopes
cameras	x-rays
MR scan	calipers

2. Give one example of how a newer technology has enabled scientists to image the human body or parts of it in a new way.

----

3. What words come to mind when you hear the word SCIENCE?

----

4. What words come to mind when you hear the word EXPERIMENT?

----

5. What words come to mind when you hear the word HYPOTHESIS?

----

6. When scientists use a variety of tools to collect a variety of evidence, they can make a more complete story or picture and increase the accuracy and certainty of solving a problem.

agree strongly   agree   don't know or not sure   disagree   strongly disagree

7. When scientists work together, sharing their findings and sharing ways of looking, it can lead to more accurate and confident results.

agree strongly   agree   don't know or not sure   disagree   strongly disagree

8. Scientific teamwork is not a substitute for scientists making up their own minds about the evidence.

agree strongly   agree   don't know or not sure   disagree   strongly disagree

3A. First version

Museum of Science and Industry--Mystery Lab--"Mystery at the Museum"

Name ______________________ School______________ Date ______

I. Tell us what the Mystery Lab program was about.

1. What did you do?____________________________________

____

2. What did you find out? ______________________________

____

II. Tell us about two new ideas you learned.

1. I didn't know that ___________________________________

____

2. I never realized that _________________________________

____

III. Tell us how the program related to what you already knew.

What did the Mystery Lab program remind you of?

1.____

____

2.____

____

IV. Anything else?

3B. Final version

Evaluation of the Museum of Science and Industry Field Trip to the Mystery Lab

Name ____________________ School________________ Grade _____ Date ______

I. In the Mystery Lab, you found out who the winning lottery ticket belonged to. You watched a video, then worked at the stations, then decided who the mystery person was. In your opinion, what was the purpose of the Mystery Lab program?

1. It was to teach us about ____________________________________

____

2. It was to give us experience with ______________________________

____

II. Tell us about two new ideas you learned.

1. I didn't know that ____

____

2. I never realized that ______________________________________

____

III. Tell us how the program related to what you already knew.

What did the Mystery Lab program remind you of?

1. ____

____

2. ____

____

IV. Any thing else?

Codes for Responses to the "Mystery at the Museum" Student Questionnaire

If a respondent restates or paraphrases one of the seven goals from *Benchmarks for Science Literacy* [1] predetermined by the museum as an educational goal, the response is coded either S for Tools of Science, N for Newer Technologies, O for Observation, V for Variety of Evidence, T for Teamwork, I for Independent Thinking, and C for Careers. A 1 or 2 indicates that the goal was hinted at or alluded to (1), or was stated clearly (2), by those who answered questionnares. Some responses may have more than one applicable code.

S We use imaging tools or machines to gather information that will let us compare things and events.

N People can shape the future by having new ideas and making new technologies, and then passing that information on to other people.

O Scientists use their own ideas and their observations to explain why things happen the way they do. When different scientists come up with different explanations for observations of the same things, they keep observing until they can decide what it means.

V There are many ways to do scientific studies. Scientists observe, collect, analyze, and do experiments when they are investigating something.

T Working with other people as a team and sharing what is discovered is a good way to solve problems, and to do science.

I When trying to solve a scientific problem with other people, it's important for everyone to come up with their own idea about what the evidence means.

C There are lots of different kinds of people working as scientists. There are scientists working at many different kinds of jobs.

GEN If a respondent gave an accurate but general response that touches on any aspect of the Mystery Lab experience, it will be rated GEN.

SAT If the respondent expresses either a positive or a negative reaction to the Mystery Lab experience, it will be rated SAT.

OT All other responses, including vague, unrelated, or illegible responses will be rated OT.

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1. Project 2061, American Association for the Advancement of Science, 1993. *Benchmarks for Science Literacy*. New York & Oxford; Oxford University Press

4). New Mystery for authentic evaluation

MUSEUM OF SCIENCE AND INDUSTRY
MEMORANDUM

To: Therese Quinn, Beverly Serrell
From: Kirsten Ellenbogen
Date: 6/2/95
Subject: FINAL RECORDED VERSION—Bursa Necklace mystery
Copies: Barry Aprison, Jill Finney, Sheridan Turner

The jeweled necklace of Bursa has been stolen from the Museum of Art. It was stolen sometime between 1 and 6 a.m. on Saturday, April 29. The Bursa necklace has an emerald and three diamonds in it and is estimated to be worth five million dollars. The necklace is usually displayed with a ceremonial cloth, made out of a rare fiber that comes from bamboo.

This infamous necklace has been in the news since the first day it was brought to the United States in 1980. Legends surrounding the necklace say that it brings bad luck to anyone who owns it. The archaeologist who discovered the necklace died of mysterious causes, as did the director of the Museum who first purchased it. Since then, even the curators at the Museum have been afraid to touch the Bursa necklace.

At 6 a.m. a guard saw that the glass cover of the display case was broken on the floor. Large pieces of glass were scattered across the room, and investigators believe that the thief may have been injured on the glass. The display case was knocked over on its side. The ceremonial cloth that had been folded under the necklace was ripped, lying on the floor a few feet away. Police dusted for fingerprints, but did not find any on the glass. A fingerprint was found on the display case. The decorative pattern on the case, however, is obscuring the fingerprint and has made it difficult to identify. Police continue to search for clues and have refused to reveal any other information about the obscured fingerprint.

Police have identified three suspects:
Ray Hunter, the guard on duty at the time of the theft;
Jane Harris, the curator who usually takes care of the pendant; and
Cleo Bursa, the supposed long-lost descendant of the original owner of the Bursa necklace.

Suspect#1: The supposed, long-lost descendant — Cleo Bursa — was first in the news in 1980, when the necklace was brought to the United States. Her grandmother came forward when she read that the necklace was purchased by the Museum. The grandmother claimed that Cleo Bursa — who was only five years old at the time — was the only descendant of the original owner of the necklace. She demanded that the Bursa necklace be turned over to her, for safe-keeping, until the young girl was old enough to keep it for herself. The Museum found no evidence to support the grandmother's claim. When the Museum refused to turn over the necklace, the grandmother withdrew her claim, and was never heard from again. Police have a photograph from the newspapers in 1980, but have not seen Cleo Bursa since that time. They suspect she may have stolen the pendant, still believing that it rightfully belongs to her.

Suspect #2: Jane Harris is a curator at the Museum who takes care of the objects in the north wing, including the Bursa necklace. She was one of the only people who had access to the necklace after regular Museum hours. In addition, police investigators found unidentified fibers on her lab coat. She claims that the fibers are from the Turkish Rug Collection she has been restoring. Police are continuing to investigate.

Suspect #3: Ray Hunter is the guard who was on duty while the necklace was stolen. He left the Museum at 6 a.m., at the same time that the new guard discovered the empty display case. He reported that he heard no loud sounds while he was on duty, and claims that he never checked the room that the pendant was in. Police put him on the suspect list the day after the theft, when he came to work with his foot in a cast. He claims that he fell at home and broke his foot. Police have taken him into custody to continue questioning him.

CLUES:

bad luck—check to see if any of the suspects are having really bad luck...this is not good evidence because it cannot be tested

glass broken—check to see if any of the suspects have suspicious cuts

ceremonial cloth was ripped—look for loose fibers on the suspects...especially because cloth is made out of rare bamboo fiber

obscured fingerprint—use fingerprint enhancement to remove the pattern i.e. make it clearer. (The specific command to remove the pattern in fingerprint software is Transform.)

photo of Cleo Bursa from the newspaper—age the photo...she would now be 20.

unidentified fibers on Jane Harris's lab coat—compare the fibers from the lab coat to fibers from the Turkish rugs and the ceremonial cloth

foot in cast—ask for the x-rays or examine his foot to see if it is really broken...he may have put the cast on to hide the fact that he cut his foot on the glass from the display case during the theft

Museum of Science and Industry--Evaluation of "Mystery at the Museum"

Teacher Workshop and **Teacher's Guide (Work Book)** and **Kit**

A. Questions about the **Teacher Workshop**

1. How did you hear about the workshop? (check any that apply)

   __Inservice __Workshop or fair __"Notebook" __MSI

   __MATM flier __ Word of mouth from ________ __Newspaper

   Other __________________

2. Do you have any special interest, knowledge or training in science?

   __ No __ Yes (explain) ______________________________

3. Did the workshop help prepare you to conduct the classroom activities and bring your students on the field trip to the Mystery Lab? (circle one)

   very much somewhat a little not really

   Comments ______________________________________

4. What about the length of the workshop? (circle one)

   It was too long It was just right It was too short

   Comments ______________________________________

5. Were your questions answered?

   __ yes __ no, I didn't find out about ___________________

6. Do you have any suggestions for improvement?

7. In what ways does the Mystery Lab program fit into your curriculum?

(please turn to the other side of the page)

B. Questions about the **Teacher's Guide and Kit**

1. How many of these activities did you use before or after the field trip?

__Hairs Looking at You Kid	List any others you did:
__Fingerprint Classification	________________
__Unique You	________________
__Coffee Mug Mystery: Who's the Culprit?	________________
__DNA Fingerprinting	________________
__Face Aging	________________
__X-rays and MRs: How Do They Differ?	________________
__What's Up Doc?	________________

2. Did you teach any human biology in your classroom this year other than the mystery lab activities?

__No __ Yes (explain) __________________________

3. Did you assess, test or grade your students' performance on the workbook activities?

No ____ Yes ____ If yes, How? ______________________

4. Do you have any suggestions for improvement to the Teacher's Guide?

5. Do you have any suggestions for improvement to the Kit?

Thank you for filling out this form. Please mail it back to MSI in the enclosed stamped envelope by ________________.