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ABSTRACT

The report describes a one-year pilot study of museum effectiveness conducted at the Franklin Institute Science Museum and Planetarium in Philadelphia. The study was intended to develop models for testing visitor response, provide useable information to museum staff, and test the feasibility of a large-scale investigation of science museums. Numerous tests and questionnaires were administered to visitors in an attempt to assess motivation for the visit, visitors' interests, exhibit preferences, orientation, attitude change, and information transfer. Results showed that the Franklin Institute audience consists primarily of groups, especially families and school classes. The average visitor leaves the museum knowing over half of the tested information content of the exhibits. Attitude toward the museum appeared to be negatively affected by building construction at the time of the study. Most of the visitors showed a favorable attitude toward science, scientists, and technology. A project to orient visitors to the museum's structure and contents produced more favorable attitudes and higher knowledge scores. Effectiveness of exhibition in terms of complexity, background colors, and participatory devices was also measured. The report concludes with a discussion of implications of the study and a bibliography of over 40 resources. (Author/AV)

MEASURING THE IMMEASURABLE:

A Pilot Study of Museum Effectiveness

by

MINDA BORUN

Conducted at: The Franklin Institute Science Museum and Planetarium
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FOREWORD

Museums provide their visitors with memorable three-dimensional visions and interactive experiences within an interpretive framework. Learning in a museum is basically a visual and kinesthetic experience which is qualitatively distinct from the kind of learning which results from a classroom lecture or printed text. Indeed, recent experiments in psychology have found that this distinction has a somatic basis, that is, that the hemispheres of the brain have distinctive behavioral attributes (i.e., visual learning is right-brained; linguistically-based information transfer, left-brained). In order to understand and utilize the full educational potential of the museum, we must include meaningful evaluation procedures in our operating programs and engage in innovative research into the mechanisms of museum learning.

All too often, evaluation degenerates into measuring what is easy and accessible rather than what a program is actually attempting to do. The primarily visual learning which takes place in the museum cannot be evaluated properly by simply copying and adapting techniques designed for the left-brained, linguistically-based information transfer found in the classroom and lecture hall. Appropriate evaluation of the museum experience in its own terms is difficult. Furthermore, the translation and interpretation of the results of such studies into usable data for the museum professional is more difficult still. Yet what other way is there to determine that the allocation of our limited resources is being done with maximal intelligence and integrity?

Today pocket-sized electronic calculators are available for $10 because people have devoted lifetimes to developing an understanding of the fundamental principles of solid state physics and the technology necessary for the economical manufacture of integrated circuits. Effective museum education is equally dependent on the application of careful research into museum learning processes and mechanisms. The status of current research tools for investigating the cognitive and expressive aspects of museum learning and the interpretation of their results is still in its empirical and theoretical infancy. If we are committed to the idea that museums are not purely passive repositories of the culture of the past but that museums are significant actors in the societal learning process, making important and singular statements necessary for a more complex understanding and intelligent decision-making, dare we continue to play blind man's buff?

JOEL N. BLOOM
Vice President and Director
Franklin Institute
Science Museum & Planetarium

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MINDA BORUN

SUMMARY AND CONCLUSIONS

I. INTRODUCTION

As new developments in science and technology reshape our world at an accelerating pace, it becomes increasingly difficult to keep the public informed about scientific and technological developments which affect daily life. Indeed, science and technology appear to most to rest in the hands of specialists who are not accountable to the layman.

The science museum shares with other educational institutions and media the responsibility for demystifying science and technology and for making new information, concepts, applications and implications accessible to the public. The museum is uniquely suited to complement most other forms of science education from classroom instruction to educational television. Its "real" objects have an immediacy that allows an intuitive grasp of scientific concepts. The multi-sensory stimulation of the exhibit merges learning with pleasure. A museum visitor is free to linger and backtrack, to explore items of particular interest, to pose problems and search for solutions. Interaction with the exhibits allows the visitor to learn science through exploration and discovery, a procedure which is better suited to scientific subject matter than the often authoritarian, print-oriented classroom experience, or the pre-packaged message of mass media.

The museum visitor can be seen as part of a special communications system in which he is the recipient of messages from the staff through the medium of the exhibit. In order to know whether or not the message has been received and understood, the museum must complete the communication process by providing feedback channels for visitor response. The science museum seeks to impart scientific and technological information, to stimulate an interest in science, and to develop positive attitudes toward science and technology. It is certainly appropriate that objective evaluation techniques be used to measure the effectiveness of the science museum in achieving these goals.

The current pervasive concern with feedback and evaluation of social and particularly educational programs represents an awareness that institutions can more successfully attain their objectives through specific assays of public response rather than through mere trial and error with overall numbers of participants as the sole indicator of success.

Conceivably, a museum might be content with mounting exhibits which demonstrate the exhibitors' grasp of their subject matter or which "impress" the audience with the wonders of science and technology. However, if the museum is honestly attempting to serve the public by bridging the gap between science and the individual, it must do more than "impress"; it must "involve". It must attempt to convey an understanding of the facts and processes of science and technology as they shape the environment of our day-to-day lives and it must arouse a concern for developing informed opinions about questions of scientific and technological applications and their consequences.

In order to know whether or not it is succeeding in these tasks, the museum must "listen to" public response. This is not to suggest that the museum be dependent on the public for its objectives, that it seek the lowest common denominator of interest and awareness. Clearly, it is the responsibility of the museum to choose and formulate its message; but it must look to the public for information as to whether or not this message is being received.

II. A PILOT STUDY OF MUSEUM EFFECTIVENESS

A one-year pilot study of museum effectiveness has been conducted at The Franklin Institute Science Museum and Planetarium, by the Association of Science-Technology Centers, (ASTC) under a grant from the National Science Foundation. The study was intended to develop models for testing visitor response, provide useable information to the museum staff and test the feasibility of a large-scale investigation of science museums. The ultimate goal of these efforts is the incorporation into museum practice of regular channels of feedback for visitor response, so that the museum becomes a flexible, self-evaluating, self-correcting institution in touch with the needs and desires of its public.

The study began with the administration of a goal-rating scale to define "effectiveness" in terms of the goals of The Franklin Institute Museum staff and visitors and of other ASTC member institutions. The resulting list of goals served as a guide to the formulation of objectives for testing visitor response. Units of measurement and measuring techniques were developed to provide baseline data -- an indication of the museum's "effectiveness" at the time of initial study.

Five questionnaires were administered to samples of from 100 to 200 visitors. The questionnaires dealt with: motivation for the visit, visitor's interests, exhibit attendance, exhibit preferences and orientation. In addition, a detailed mail-back questionnaire was given to a sample of teachers of visiting school groups

Attitudinal change and information transfer were measured by means of a multiple choice test (see Appendix D). The affective section of the test provides indices of: interest in science, understanding of the impact of science and technology on daily life, attitudes towards science and technology, and attitude toward the museum. The cognitive section was designed to measure learning of basic science information through a test of vocabulary, experience and concept formation.

The method of test presentation was novel and quite successful. Visitors took the "museum quiz" in a portable "testing machine"; a booth resembling a study carrell equipped with rear-projection screen and push-button response mechanism. (See Figures 2 and 3 pp. 29-30). Test questions appeared on color slides of actual exhibits. Visitors selected answer buttons which entered their choices on punch cards. This apparatus was designed and used in place of a paper and pencil test to provide a visual stimulus and to make the test more like a game than a school-room experience.

Baseline data was obtained in order to have a basis of comparison for measuring the impact of possible changes and improvements. Learning and attitude measures are based on a comparison of pre-visit and post-visit test scores. A random sample of approximately 250 visitors received the pre-test and another sample of approximately 250 visitors was post-tested, making a total baseline sample of 500 visitors.

III. SUMMARY OF BASELINE DATA

A. The Visitors

The Franklin Institute audience consists primarily of groups. From September through June school groups predominate on weekdays and families on weekends. The summer visitors are similar to the weekend family groups, but with an increase in out-of-town tourists.

When a school class visits, the museum is usually the focal point of the day. Teachers tend to become regular museum visitors, incorporating a class trip to the museum into their school year. The teachers see the museum as an adjunct educational institution and stress the stimulation value of a museum visit -- the increase in interest and receptivity to further learning shown by their students after a museum visit. (See Appendix A).

B. <u>Learing from the Exhibits</u>

The results of the cognitive test show a clear increase in score from pre- to post-visit test. The average visitor leaves the museum knowing over half of the tested information content of the exhibits. Since the study dealt with "casual visitors" whose primary goal was entertainment and who spent only 2 or 3 hours in the museum, it is impressive that this much information transfer does occur.

The highest increase and highest absolute score are found in the youngest age group. Further, while there is a positive correlation between education and score on the pre-test, this is not true of the post-test where children in grades 7-9 obtain higher scores than college students and those in graduate school. It is apparent that school children are absorbing a good deal of exhibit content during a museum visit. This is a strongly positive finding, since school-age children are the audience for which most of the museum's exhibits have been designed. Further, this group represents a large segment of the museum's visitor population. Our data support the notion that science museums can effectively serve as adjunct learning facilities which supplement the classroom and other educational media.

With regard to levels of learning, the greatest increases are seen on the vocabulary and concept learning sub-scales. There is a smaller increase on the experience sub-scale, which is based on learning through direct participation. This difference may be due in part to the nature of the testing procedure, which, although making use of visual stimuli and push-button response, did present written questions and answer choices as opposed to asking for a behavioral demononstration. A performance task might have yielded better results in testing material learned by direct experience.

C. Attitude Towards The Museum

Results of the first rating scale show a clear decrease from pre- to post-visit test in positive feeling about the museum. This shift is disturbing for an institution dedicated to providing a pleasurable learning experience to its visitors. It is probably due primarily to the temporary confusion and disorder associated with Bicentennial-related construction in the museum building. Initially, the decrease might have been interpreted as an artifact of the change from anticipation of, to reaction to, the actual visit, with fatigue operating to further dampen post-visit attitudes. However, the results of a second round of visitor testing to measure the effectiveness of an experiment in orientation (discussed in detail in Section V) indicate that a highly positive response can be maintained.

D. Attitude Toward Science, Scientists and Technology

The museum's visitor population was found to have a strongly favorable attitude toward science, scientists and technology. However, all of the questions and sub-scales show a slight, but statistically significant negative shift from pre- to post-visit test. This is particularly apparent in the case of returning visitors (i.e. 60% of visitors) and probably reflects the effects of the Bicentennial-related construction noted above which took place during the testing period. Visitors who had come to the museum previously had higher expectations and were no doubt disappointed.

If the negative shift were indicative only of a change in attitudes toward science and technology, we would expect greater variation from question to question. Instead, there is a strikingly uniform decrease from pre- to post-test. This suggests that the general gestalt of the building is influencing visitors reaction to the communication of exhibit content.

IV. AN EXPERIMENT IN VISITOR ORIENTATION

The second phase of the pilot study involved the application of our measuring instruments and testing procedures to the evaluation of selected changes in museum operations.

The problem of visitor orientation was picked as a focus for experimentation. Changes in orientation procedures were made and visitors were retested to see if these changes produced improved scores on our cognitive-affective test. In effect, this experiment served to determine both the utility of the cognitive-affective test and testing machine and the value of changes which were designed to alleviate problems revealed by preliminary orientation studies.

The orientation of visitors to the structure and contents of the museum is an important aspect of the visit and one which is often low on the list of priorities of the museum staff. An analysis of visitor orientation at The Franklin Institute revealed that this was a major problem area, making the visit somewhat less satisfying and instructive than it might otherwise be.

Our experiment in visitor orientation was based on the hypothesis that entering visitors need a place at which they can pause and become oriented to the museum and where they are encouraged to make conscious choices about what they want to see and how much time they want to spend.

For the purposes of the experiment an information desk was set up near the main museum entrance and three pilot orientation brochures were prepared (See Appendix C):

1. "Highlights Tour" - a sequence of exhibits for first-time visitors.
2. "Search and Discover" - a question game for parents and young children.
3. The "Museum Adventure Trail" - a quiz sheet with more challenging questions, for older children, teenagers, and interested adults.

The cognitive-affective test was readministered to a sample of 500 visitors and scores of individuals who had used one of the orientation handouts were compared to visitors who had not used a handout. The "Highlights Tour" produced no significant improvement in general quiz score or in attitude. "Search and Discover" increased both attitude and quiz scores for parents who used the quiz with their children. In addition, their written comments on the experience were highly favorable. "Museum Adventure Trail" produced increased attitude and quiz scores for all age groups and a very large improvement in attitude toward the museum.

This experiment in orientation indicates that:

1) A Fall in post-visit attitude toward the museum is not a necessary concomitant of the end of a visit.

2) Visitors enjoy a self-administered quiz; such a device stimulates museum-based learning.

3) The pilot study has generated a test instrument and procedure which is useful in evaluating changes in museum operations.

V. EXHIBITRY

Once we have determined what the visitors see, how they get there, what they learn, and what they like, we would then like to know why some exhibits are more "effective" than others -- what are the elements of which a good exhibit is composed.

Although this study was not designed to address this issue with rigor, it is possible to make some inferences with respect to the effect of several exhibit variables on the attracting power, instructional power and popularity of existing museum exhibits, using our exhibit attendance and rating questionnaires and cognitive test scores as indices of effectiveness. The variables which have been examined are: visual complexity, background color and visitor participation.

1) Complexity

A comparision of the number of displays in an exhibit hall and the popularity of the exhibit indicates that:

> *visitors prefer the more complex exhibit halls, having 30 - 40 displays per room as opposed to the halls having a sparser, more contemporary display style (See Figure 7, p. 65).*

2) Background Colors

With regard to background, it appears that:

> *there is a negative correlation between popularity and number of background colors (See Figure 8, p. 65).*

3) Participation

In terms of participation:

> *our data show a direct correlation between popularity and number of participatory devices (See Figure 9, p 69).*

However we also see that:

there is a strong inverse correlation between instructional power and number of participatory devices (See Figure 10, p. 69).

When pushbuttons are separated from other participatory devices, we see that:

pushbuttons account for most of the negative correlation with instructional power.

It is concluded that pushbuttons, which do work well to attract attention, are appropriate to introductory and transitional area of an exhibit, but are not effective aids to the communication of scientific facts and principles. Unlike pushbuttons, successful participatory devices allow visitors to manipulate the environment, to conduct experiments, to introduce changes and to observe the results.

VI. THE MUSEUM'S EFFECTIVENESS

The pilot study began with a goal-rating scale. The report concludes with an assessment of the museum's effectiveness in achieving its stated goals. Briefly, the museum was found to be highly effective in terms of teaching basic science concepts but much less so with respect to the affective goals of stimulating and developing curiosity, interest in science, and positive attitudes toward science and technology. This is not surprising in the light of the extremely high initial scores in these areas evidenced by entering visitors. No gain was found with respect to understanding "the impact of science and technology on daily life" and that "science is a process, a way of looking at things". These areas were not explicitly treated in the museum's exhibits at the time of the study. If increasing public understanding in these areas is a significant goal, relevant information must be explicitly presented in the exhibits.

The initial fall in "positive feelings about the museum" and the improvement as a result of our orientation experiment, point up the importance of attention to this area.

VII. A NOTE ON COGNITIVE TESTING IN MUSEUMS

Various investigators have attempted to measure museum-based learning by testing the casual visitor (Parsons, 1968; Shettel, 1968; Eason and Linn, 1975). With reports of short times spent and few labels read, the tendency has been to assume little, if any, learning on the part of the casual visitor during a typical 2-3 hour visit. Generally, the results have indicated relatively little information-transfer. Eason and Linn (1975) in their study of two optics exhibits at The Lawrence Hall of Science, report an average increase of 10 percentage points.

The somewhat greater average increase seen in the case of The Franklin Institute study (18 percentage points) can probably be attributed to the use of a visual stimulus and participatory response mechanism in place of a paper and pencil test. Eason and Linn found that while only 11% of the 5th and 6th graders tested gave correct answers to a written question, 60% gave correct answers when the same question was presented in the form of a diagram. They conclude that the improvement is due to the fact that in the second case, understanding of the question is not based on reading ability. The questions on The Franklin Institute test were written (and hence dependent on reading ability for comprehension) but since they were accompanied by a color slide of the museum display to which the question referred, it seems that the stimulus value of the visual image is a significant factor in explaining the increase in score. This would also apply to Eason and Linn's diagrams.

As has been noted, higher learning scores were achieved on our vocabulary and conceptual sub-scales than on the experience questions. Perhaps if experimental learning had been tested by means of a performance task, higher increases might have been found, since a performance task would be more congruent with the participatory museum experience.

VIII. STUDYING THE MUSEUM

The world of the museum and its visitors lends itself to study from a wide variety of points of view including ethnographic description of visitor behavior, careful testing of visitors' response to specific parameters of experimental exhibitry, and experiments with programmed learning devices. Each technique and research paradigm, when used exclusively, has its own limitations.

In the field of museum research, where so much remains unknown, we need an eclectic approach in which different techniques are combined. Since museum studies tend to involve not only measurement itself but also developing measuring instruments and units of measurement, the best strategy involves overlapping approaches to allow cross-checking of findings.

The museum literature is replete with concepts of exhibitry formulated by experts in the museum field. Yet, a careful study of exhibit rating by museum experts (curators, directors, designers, etc.) revealed that there is no agreement among them as to what makes a good exhibition (Shettel, 1965). The only way to resolve these differences and provide a solid foundation for museum decision-makers is through empirical research.

Clearly, we need systematic studies of visitor response to controlled variation of exhibit components in order to understand how color, lighting, labelling, placement of objects, number, size and complexity of objects, and type of display can attract and hold visitors' attention and contribute to measurable "cognitive gains". It's important for us to come to understand the nature of the visitors' reaction to a museum visit to explore the instructional effectiveness of different types of exhibits, to appreciate the dynamics of visual and interactive learning, and to incorporate this understanding into the exhibit-making process. In addition, we need comparative studies of data collected in a range of institutions, in order to distinguish general principles of exhibitry and visitor response from the effects of specific museum contexts. The pilot study discussed here and the other references cited are a beginning; there is much yet to be done.

IX. LIMITS TO THE UTILITY OF EFFECTIVENESS RESEARCH

By emphasizing the need for research we do not mean to suggest that studies of exhibit effectiveness and visitor response will eventually lead to the production of a "how-to-do-it" cookbook, a complete guide to building successful museum exhibits. On the contrary, the sphere of usefulness of such studies is definite and limited.

There exists a set of basic principles about museum exhibitry and visitor behavior which is discoverable through empirical research. Effectiveness studies such as this one which explore fundamental patterns of visitor response can give us boundary information, indicating limits to effective museum presentations. They cannot specify the content of exhibits. They can serve as tools for use in planning an exhibit in that they tell us some general things not to do. They cannot tell us how to choose from the broad range of possibilities which could create a successful exhibit. This has been and will remain the domain of designers and other museum professionals and will continue to require the application of their experience and art.

I. PREVIOUS STUDIES

Serious attempts to assay visitors' response to museum exhibits began in the United States in the late nineteen twenties and early thirties (Robinson, 1928; Melton, 1933 a-b, 1935, 1936). Interest quite naturally turned elsewhere during World War II. There was a renewal of concern with exhibit effectiveness in the fifties. Government agencies attempted to measure the impact of overseas information exhibits (e.g., peaceful uses of atomic energy, Shettel, 1966). The last twenty years have seen the renewal of activity in museum self-evaluation. Small, often unpublished projects have been carried on by museums, marketing firms and university students. Recently, the Smithsonian Institution embarked on a large-scale project to study the museum visitor (Wells, 1969). Literature in the museum field is now calling for a standardization of evaluation techniques and the publication of results.

Figure 1 is a model of a museum visit[1] which provides us with a set of categories for the following brief discussion of museum studies to date[2]:

1. Awareness of Museum

   Research in this area consists largely of unpublished institution-specific marketing studies of museum public relations activity. With regard to visitor attitudes, Harris Shettel, at the American Institute for Research in Pittsburgh, Pennsylvania, has found that

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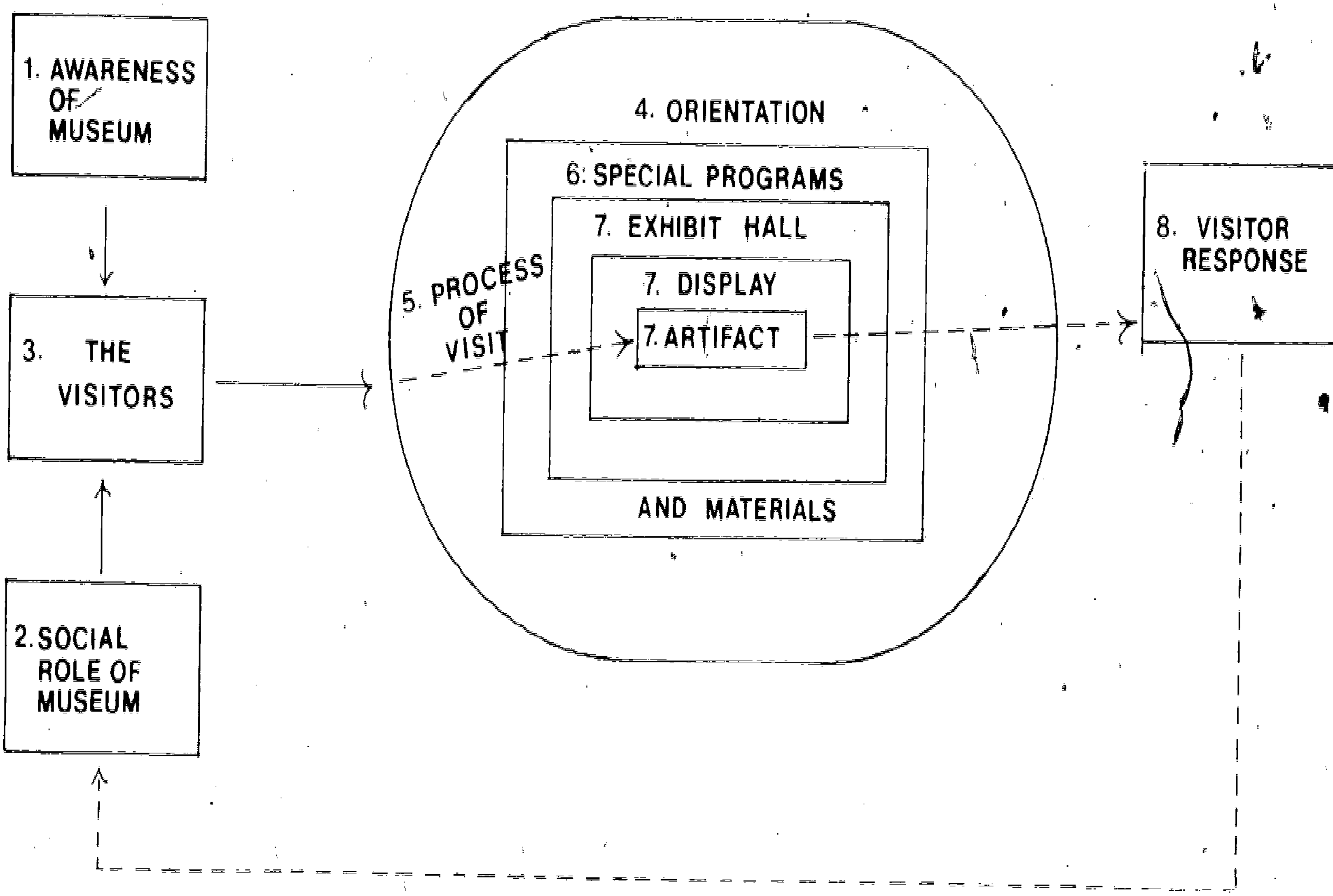
[1] This model is adapted from one which appears in: Loomis, Ross, 1973, "Please, Not Another Visitor Survey," Museum News, 52(2), October, 1973.

[2] For a fuller discussion of this topic see: Borun, Minda, 1975, "Museum Effectiveness Study - A Bibliographic Review," The Franklin Institute, June, 1975.

FIG. 1 Model of Museum Visit



the promotional material put out by a museum about an exhibit frequently has a more significant influence on public attitudes than the exhibit itself (Shettel, 1966).

2. Social Role of Museum

Current work, being done from the viewpoints of sociology and social psychology, provides interesting descriptive information. Such data are relevant to museum policy-making in instances where a discrepancy between staff objectives and actual use of the museum is found and it is advisable to attempt to modify one or the other.

3. The Visitors

The standard survey of visitor demographics has been done at many museums. The scale and quality of such surveys vary greatly; but, in general, the interview method is widely known, and the gathering and interpretation of such data is relatively straightforward. The model for a large-scale demographic survey is the study done at the Royal Ontario Museum in Toronto by Duncan Cameron and D. S. Abbey (1959, 60, 61).

Sometimes comparisons of demographic data can reveal interesting parallels in attendance patterns at different museums. For instance, a study done at the St. Paul Science Museum in 1938 (Powell) demonstrated the same pattern of seasonal attendance as has been observed during the last five years at The Franklin Institute.[1] Apparently

[1] The peak for local visitors occurs in the early spring when the cold season ends. School groups come in greatest numbers in the late spring from April to early June, and local visitors and tourists form another attendance peak in August.

this pattern is determined by weather and vacations and only slightly varied by changes in the quality and subject matter of museum exhibits. Clearly, this type of information is useful when making scheduling decisions directed toward producing special exhibits and programs having maximal impact.

4. Orientation

The problem of conveying to visitors an understanding of the structure and contents of the building has recently become a focus of interest in the museum community. Inadequate orientation has been found to lessen the teaching effectiveness of museum exhibits (Lakota, 1975). Many museums are experimenting with various orientation systems and devices. A good review of the "state of the art" has been written by Marilyn Cohen at the Smithsonian Office of Museum Programs (Cohen, 1974).

5. Process of Visit

This was one of the first areas of systematic visitor research. Tracking and timing of visitors by "unobtrusive" observers provides some very basic time-motion data. Such studies have found that there are certain fundamental facts about visitor behavior which museum personnel would do well to understand. For example, most people who enter an exhibit hall in which the central path is blocked turn right and proceed in a counter-clockwise direction (Melton, 1933 a-b). The problem with a right turn is that it sets up a path which runs counter to the left to right direction of reading printed material. This is particularly awkward in the case of a multi-panel sequence with a good deal of text. The Milwaukee

Public Museum solved the problem by setting up a deflector exhibit at the entrance to the hall so that the right side is obscured and people are routed to the left. There was an increase in label reading and in information retention (as revealed by comprehension testing) when people proceeded in a clockwise fashion (Borhegyi and Hanson, 1968).

Another relevant behavioral fact is that when there is a doorway opposite the entrance to a hall, visitors tend to view only those displays located on the right-hand wall and in the center of the exhibit hall, thus missing the displays along the left wall. Simply explained, when visitors come to a doorway, they leave. Also there is an exit-gradient in interest. The greatest amount of time tends to be spent looking at displays to the immediate right of an entrance, with the time per display decreasing as an exit is approached (Melton, 1933).[1]

6. Special Programs and Materials

The presentation of special programs and the distribution or sale of exhibit-related materials overlap to some degree with orientation. This area is frequently the domain of the Education Division of the museum. Katherine Goldman at the Smithsonian has edited a volume based on a National Science Foundation Conference dealing with efforts to expand special museum programs in the area of pre-college science education (1970). Generally, short-term unpublished evaluations of these activities are carried on by the museum staff.

[1] Our experiments in museum orientation (Section V) involve attempts to guide the visitor and to alter some of these behavior sets.

7. Exhibit Halls, Displays, Artifacts

Perhaps the most important data in the field of museum studies has come from systematic experimentation using controlled variation of exhibit components. Visitors have been tracked and timed and their behavior monitored by unobtrusive observers and, more recently, through the use of video-tape and time-lapse photography. This behavioral data is then correlated with features of exhibit design (Robinson, 1930; Melton, 1935; Goins and Griffenhagen, 1958; Borhegyi, 1968; Parsons, 1968; Shettel, 1968).

8. Visitor Response

In order to evaluate specific display components and techniques, it is necessary to have some objective measure of success. The most commonly used measures are "attracting power" (numbers of visitors) and "holding power" (average time spent). These are presumed to be indirect measures of interest and understanding.

There are obvious problems with such indirect measures. Time spent is not necessarily an indication of interest or of what is learned. In order to directly measure the teaching effectiveness of particular exhibits and of a museum visit as a whole in stimulating visitors' interest, one has to devise a way to test the visitors to see what they have learned and how they feel about it.

Most efforts at cognitive testing of museum visitors have focused on school children (Brooks and Vernon, 1956; Garvin, undated; Reese and Moore, 1961). With respect to affective response Ray Pierotti (1973) has found that museum visitors are unable to directly verbalize feelings and ideas about their experience. In order to elicit this information, it is necessary to use standardized psychological tests such as the semantic differential, agreement scaling, etc.

In our pilot study at The Franklin Institute, we have developed a set of tests and questionnaires which can provide baseline data on visitor response and serve as diagnostic tools for measuring the success of attempts to improve the museum and specific exhibits.

II. THE VISITORS

The interviewing and testing of Franklin Institute visitors took place at intervals beginning in September, 1975, and concluding in August, 1976. Data on the visitor population is divided into three groups. From September through June we have (A) weekend visitors and (B) school groups or weekday visitors. During July and August there are (C) summer visitors.[1]

A. Weekend Visitors

The following data is based on two questionnaires distributed to a total sample of 700 visitors on three weekends in the fall of 1975 and two in the spring of 1976.

1. Over half of the weekend visitors are local:

Philadelphia	27%	56%
Suburbs	29%	
Other Pennsylvania	9%	
New Jersey	13%	
Tourists	20%	
Northeast 10%		
Southeast 3%		
Midwest 2%		
West 2%		
Non-U.S. 3%		
Miscellaneous	2%	

2. Most visitors are not members of The Franklin Institute:

Members	11%
Non-members	89%

[1]In the summer the difference between weekday and weekend visitors is one of numbers rather than demographics; consequently, we have treated this as a single group.

3. Most visitors come in family groups averaging 2-4 people:

GROUP		92%
Family	49%)	
Friends	34%)	
Other	9%)	
CAME ALONE		8%

WHY CAME?

To bring the children	32%)	) 56%
Family outing	24%)	
Touring Philadelphia	11%	
Show an out-of-town visitor	9%	
On a group tour	8%	
Show museum to friends	6%	
Class trip	2%	
Other	8%	

4. The majority of visitors are returning to the museum:

HOW MANY PREVIOUS VISITS?

Return visit		60%
Sixth visit or more	27%)	
Third-fifth visit	17%)	
Second visit	16%)	
First visit		40%

5. The first visit is usually made with the family, but school groups are also important:

FIRST VISIT?

Family	47%
School group	33%
Friends	15%
Other	5%

31

6. The period of repeat visiting is large.

LAST VISIT?

1-5 years ago	36%
More than 5 years ago	25%
6 months-1 year ago	21%
Less than 6 months ago	18%

7. Although most visitors come from Philadelphia and the surrounding suburbs, a visit to the museum is usually combined with other activities in Philadelphia:

OTHER ACTIVITIES TODAY?

Seeing other Philadelphia sights	37%
Going to a restaurant	20%
Visiting friends	12%
Shopping	10%
Theater or concert	7%
Zoo	4%
Movies	4%
Sporting event	4%
Other	2%

8. Most visitors plan to spend 1-3 hours in the museum.

PLAN TO STAY?

2-3 hours	45%
1-2 hours	35%
More than 3 hours	19%
Less than 1 hour	1%

9. Adults and elementary school children are the most frequent visitors:

AGE?[1]

5-11 years old	39%
Adults (22+)	27%
12-21 years old	23%
Under 5 years old	4%
Miscellaneous (age unknown)	7%

10. Most visitors come to see the whole museum or the Planetarium rather than a particular exhibit. Demonstrations also have a special appeal:

WHY CAME?

To see what's in the museum	38%
To see a Planetarium show	30%
To see the demonstrations	23%
To see a special exhibit	9%

11. Visitors see themselves as coming to the museum primarily for amusement and secondarily to learn science:

WHY CAME?

For fun	33%
To learn something about science	21%
Because like museums	19%
To learn how things work	16%
To learn how science and technology affect daily life	11%

[1]From cashiers' accounts: Gates, Donald, "Summary of Attendance for 1975," The Franklin Institute, 1976.

B. <u>School Groups</u>

Groups of school children are the predominant visitors to the museum on weekdays from September through June. Since their presence is largely due to a decision on the part of their teachers, a mail-back questionnaire was distributed to the teachers.[1]

1. The following is a summary of the grade distribution of visiting school groups[2]:

Grades 4-6	42%
Grades 7-9	21%
Grades K-3	19%
Grades 10-12	5%
Miscellaneous	13%

2. Reasons for class visits were similar to those given by family groups, but a higher priority is given to science learning:

WHY CAME?

To teach class something about science	25%
To see a Planetarium show	22%
To show class what's in The Franklin Institute Museum	20%
For fun	18%
To supplement a classroom science unit	15%

---

[1] Of 200 questionnaires distributed, 59 (30%) were returned. Generally, one third is an excellent return rate on mail-back questionnaires.

[2] Based on Museum reservation records: Gates, Donald, "Summary of Attendance for 1975," The Franklin Institute, 1976.

3. Approximately one half of the teachers had been here before with a school class:

NUMBER OF VISITS?

Return visit	53%
First visit	47%

4. Of those on a return visit, 67% had brought a class to the museum last year.

LAST VISIT?

6 months-1 year ago	52%)	) 67%
6 months ago	15%)	
1-5 years ago	27%	
More than 5 years ago	6%	

5. Groups spend one to four hours in the museum:

HOW LONG?

2-3 hours	42%
3-4 hours	27%
1-2 hours	24%
4 hours	7%

6. The museum visit is the only activity that day for over half of the groups:

WHAT ELSE DID YOU DO?

Nothing else	54%
Other Philadelphia sights	23%
Regular school program	23%

7. Teachers consider the museum visit to be a positive learning experience for the students:

VISIT RATING?

Excellent	34%
Above average	31%
Average	27%
Below average	8%
Poor	0%

8. Teachers feel that the value of a visit lies in stimulating children to seek further information rather than in how much is learned while in the museum itself.[1]

9. According to their teachers, students really enjoyed their visit:

DID STUDENTS LIKE VISIT?

Like very much	83%
Somewhat	14%
Not at all	0%
No answer	3%

The teachers themselves were somewhat less strongly positive:

DID YOU LIKE VISIT?

Like very much	69%
Somewhat	24%
Not at all	2%
No answer	5%

[1]For fuller discussion of this point, see Appendix A, teachers' comments on carry-over effects of visit.

Yet most of the teachers intend to continue to bring their classes to the museum:

PLAN TO RETURN?

Interested in bringing another class	85%
Not interested	10%
No answer	5%

C. Summer Visitors

On the whole, even during the "Bicentennial Summer," summer visitors are similar to year-round weekend visitors except that there is an increase in the number of tourists in comparison to local people:

WHERE FROM?	WEEKEND		SUMMER	
Philadelphia	27%)	) 56%	24%)	) 48%
Suburbs	29%)		24%)	
Other	44%		52%	

Also the proportion of family groups is somewhat higher during the summer.

CAME WITH?	WEEKEND	SUMMER
Family	53%	65%
Friends	37%	29%
Other	10%	6%

3?

D. Visitors' Interests[1]

1. Most visitors report an interest in science. Also popular are crafts, music, art and sports:

INTEREST?

Science	68%
Crafts	39%
Music	37%
Art	32%
Sports	32%
Social Science	28%
Politics	15%
Literature	15%
Other	7%

2. In the sciences, interest is evenly divided among physical, biological and social sciences with a much lower percentage interested in math:

SCIENCE INTEREST?

Physical science	46%
Biological science	45%
Social science[2]	45%
Math	17%

[1]Total exceeds 100% since multiple selections were allowed.

[2]When social science is listed as a science, expression of interest increases in comparison to that shown when social science is listed separately.

3. A question about leisure-time activities produced the following distribution:

LEISURE INTEREST?

Read	48%
Visit friends	32%
Sports	31%
Theater or concert	31%
T.V.	30%
Movies	27%
Shopping	17%
Other	9%

E. Awareness of the Museum

Approximately one half of the visitors had recently heard about the museum. Most information came through "word-of-mouth" networks of friends or relatives:

HEARD ABOUT MUSEUM RECENTLY		53%
Friends or relatives	27%)	
School	9%)	
T.V.	7%)	
Newspaper	5%)	
Magazines	1%)	
Radio	1%)	
Tourist Bureau	1%)	
Other	2%)	
DIDN'T HEAR ABOUT MUSEUM RECENTLY		47%

F. Summary

The museum audience consists primarily of groups. From September through June school groups predominate on weekdays and families on weekends. The summer visitors are similar to weekend family groups, but with an increase in out-of-town tourists. Visitors consider themselves to be very interested in science. They have come to the museum to entertain themselves and their families and to learn science.

Among the school groups, elementary school grades 4-6 are most prevalent. When the class visits, the museum is usually the focal point of the day. Teachers tend to become regular museum visitors, incorporating a class trip to the museum into their school year. The teachers see the museum as an adjunct educational institution and stress the stimulation value of a museum visit - the increase in interest and receptivity to further learning shown by their students after a museum visit. They also feel that science facts and concepts are assimilated during the visit itself. Teachers perceive the children as having a strongly positive reaction to the visit.

G. Implications

On the basis of information about the visitors and their interests and the power of "word-of-mouth" communication, it seems apparent from the present study that museum publicity should emphasize reaching family groups and to some extent school groups, both of which are frequent visitors and sources of informal public relations. The focus should be on family activity, fun, learning science, and on a visit to the museum as an important local sight-seeing activity. On the other hand, if it is thought desirable to augment the present audience, attention might be directed toward those segments of the community which are currently under-represented, such as teenagers and inner-city residents.

III. TESTING VISITOR RESPONSE

A. Definition of "Effectiveness"

To measure the effectiveness of museum exhibits, we must have a clear definition of staff goals. To this end we began our "Museum Effectiveness Study" by distributing a goal-rating scale to The Franklin Institute Museum senior staff and to directors of ASTC member museums. A similar scale was given to a sample of visitors at The Franklin Institute. Results of all three served as a guide to the formulation of objectives for measuring exhibit effectiveness through the testing of visitor response.

B. Goals of Museum Staff

The results of The Franklin Institute staff's rating of goals were (in order of importance):

1. Stimulate an interest in science.
2. Develop an understanding of the impact of science and technology on daily life.
3. Stimulate curiosity.
4. Entertain, amuse, give pleasure.
5. Develop positive feelings about the museum and a desire to return.
6. Teach basic science concepts.
6.[1] Teach that science is a process, a way of looking at things.
7. Develop more positive attitudes toward science and technology.

---

[1] Duplicate numbers indicate tied scores.

The same rating scale was sent to ASTC museum directors with the option of filling it out themselves or distributing it to their senior staff and returning the totals. We received a response from 15 institutions and over 40 individuals.

While there was a considerable amount of variation both within and between institutions, the overall result showed substantial agreement between The Franklin Institute staff and that of other ASTC members.[1] The cumulative ranking for ASTC members is given below, to the left of The Franklin Institute list:

ASTC	Franklin Institute	
1.	1.	Stimulate an interest in science.
3.	2.	Develop an understanding of the impact of science and technology on daily life.
2.	3.	Stimulate curiosity.
5.	4.	Entertain, amuse, give pleasure.
7.	5.	Develop positive feelings about the museum and a desire to return.
4.	6.	Teach basic science concepts.
5.	6.	Teach that science is a process, a way of looking at things.
6.	7.	Develop more positive attitudes toward science and technology.

Some additional goals which were suggested by ASTC members include:

1. Bridge the gap between scientific research and public knowledge.
2. Demonstrate ways that visitors can pursue their interest in science.

[1] Correlation coefficient = .[illegible] (Spearman's rho).

3. Provide clear orientation information about buildings, exhibits, etc.

4. Stimulate the creativity of science teachers so that it carries over into the classroom.

C. Goals of Visitors

The use of goals as the basis for formulating objectives is appropriate for evaluation only if the goals themselves appear to be reasonable. It is important to determine whether staff goals overlap with those of the visitors. Thus similar questionnaires (see Appendix B) were distributed to a sample of visitors (N=170) at The Franklin Institute. Results of the visitor questionnaire show that although there is a difference in priorities, no great disparity between staff and visitors was present. Visitors' goals in order of frequency of selection are:

1.	Fun	39%
2.	Learn something about science	25%
3.	Entertain the children	21%
4.	Do something with the whole family	15%

Visitors do come to the museum both to learn science and for entertainment. However, while the staff sees various aspects of science learning as the highest priority, the visitor places amusement first.

D. Objectives for Evaluation

Objectives for testing the response of museum visitors were derived from staff goals. A two-part multiple-choice test was developed (see Appendix C). The affective section involves measuring: interest in science, feelings about the impact of science and technology on daily life, attitudes toward science and technology, and attitudes toward the museum.

The cognitive test, on the other hand, is designed to measure learning of basic science information contained in a sample of exhibits.[1]

1. The Affective Test

   a. The affective test consists of two components:

      (1) Questions about subjective reaction to the museum.[2]

      (2) An attitude test consisting of three sub-scales which, when combined, give a score for general attitudes toward science, scientists and technology and which, when considered individually, give ratings for:

         (a) Interest in science e.g., Question #5: "Which of these statements do you agree with most?"

            A. "Science education is a 'must' these days.

            B. "It's always interesting to learn science."

            C. "Science is not as important as other subjects."

            D. "Science is boring."

         (b) Science is good or bad e.g., Question #6: "Science makes our way of life change too fast."

            A. Agree

            B. Sort of agree

            C. Sort of disagree

            D. Disagree

         (c) Perception of impact of science e.g., Question #7: "How much does our country's future depend on scientific research?'

            A. Not much

            B. A bit

            C. Pretty much

            D. Very much

---

[1] Only a limited number of exhibits were available for testing purposes, since the majority were undergoing renovation or replacement for the Bicentennial.

[2] Farber, Irving, "Faces Test," Affective Testing Division, Philadelphia School District, 1975 (personal communication).

Questions for the attitude sub-scales are derived from a series of validated, educational testing instruments.[1]

b. Scoring the Attitude Test

Integer scores were assigned to each of the choices on the attitude test so that the most negative choice received a value of +1, less negative +2, etc., up to the most positive choice. There were two main question formats:

(1) Agreement with positive or negative statement (e.g., Question #61: "Which do you agree with?")

A. "Science is so hard only trained scientists can understand it."

B. "Most people can understand the work of science."

Here the negative statement is scored +1, the positive statement +2.

(2) A positive or negative statement followed by a graded series of agree/disagree choices (e.g., Question #65: "Scientists dig into things they ought to leave alone.") .

A. Agree

B. Sort of agree

C. Sort of disagree

D. Disagree

---

[1] Attitude questions have been adapted from:

Moore, Richard Worthington, The Scientific Attitude Inventory, Ph.D. thesis, Temple University, March, 1969.

Schwirian, Patricia M., "Science Support Scale," Science Education, March, 1968, 52, 172-179.

Dutton, Wilbur H. and Stephens, Lois, "Attitudes Toward Science," School Science and Mathematics, January, 1963, 63, 43-49.

National Research Company, Survey of Public Attitudes Toward Science, Princeton, N.J., 1972.

Shettel, Harris H. et al, Strategies for Determining Exhibit Effectiveness, Bureau of Research, American Institutes for Research, Pittsburgh, Pa., April, 1968.

For scoring purposes, full agreement with a negative statement about science would be scored as +1, disagreement as +4.[1] To clarify the interpretation of the results, point value scores per visitor have been converted to a normalized group mean. Thus, a score of 50% represents a neutral attitude. Anything above 50% is a positive attitude; below 50% represents a negative attitude.

2. The Cognitive Test

a. Sub-scales

The cognitive test is also composed of three sub-scales. Considered collectively, they yield a score on the exhibit-based "quiz" which is our general measure of the learning of exhibit content. Individually, the scales measure a hierarchy of learning skills.

(1) Vocabulary

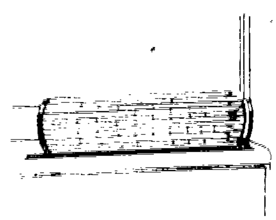
Identification of display item based on content of written labels e.g., Question #25: "What is this?"

A. Thermometer

B. Pressure Gauge

C. Compass

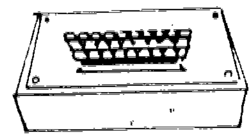
D. Slide Rule



[1]While one might question the legitimacy of assigning integer intervals between all choices, or giving a greater point range to questions with a larger number of choices, this scoring procedure does give us an unambiguous method for evaluating responses and yields a very general positive or negative score which serves as an attitude summary.

(2) Experience

Recall of interactive experience e.g., Question #10: "What does this do?"



A. Play tunes

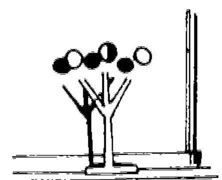
B. Punch cards

C. Write letters

D. Add and subtract

(3) Concept Formation

Understanding of basic science concepts e.g., Question #37: "What holds the balls up?"



A. Steam

B. Air pressure

C. Magnetism

D. Gravity

b. Scoring the Cognitive Test

Our purpose in giving visitors a quiz on the content of selected museum exhibits was to see how much exhibit information was learned in the course of a single visit to the museum. An attempt was made to provide questions covering all areas and levels of content in the test exhibit halls. A separate pre-test group (visitors tested before their museum visit) served as a control to tell us how much of this information visitors already knew. Thus, the difference between the mean score of pre-visit and post visit samples is o measure of museum learning.

For purposes of scoring the cognitive test, visitors were selected from the pre- and post-test groups for each test question on the basis of their answers to questions on exhibit attendance. Thus, the pre-test group for each question consists only of people in the pre-test sample who indicate that they have never seen the exhibit hall containing the display in question; the post-test group consists only of people in the post-test sample who have just seen the particular exhibit.[1]

On the basis of preliminary test results, the test itself was corrected by the elimination of questions which were too simple (over 75% correct on the pre-test).

E. Method of Test Presentation

A portable "testing machine," a booth which resembles a study carrel and contains a rear-screen projected slide-test and push-button response mechanism, was used to present the cognitive-affective test to a random sample of museum visitors (see Figures 2 and 3). Test questions appear on color slides of actual museum exhibits. Visitors enter their responses by pushing buttons on a multiple-choice response device which punches the answers on punch cards. This apparatus was designed and used in place of a paper and pencil test to make the test more like a game than a schoolroom experience. In practice, visitors were willing to take a 75-question test (15-20 minutes) and seemed to enjoy the process. The refusal rate was low. In fact, we had to hang a sign saying: "Museum Visitor Test, Random Sample, No Volunteers Please" to help us turn away would-be participants.

[1] The sorting and scoring process for both affective and cognitive tests was accomplished by computer.

F. Experimental Design

Baseline data (a measure of visitors' response to the museum at the time of this study) was obtained in order to have a basis of comparison for measuring the impact of introduced changes.

A pre-visit random sample of approximately 250 visitors received the test after paying admission (see Appendix E). Another sample of approximately 250 visitors was tested just before leaving the building. People taking the post-visit test did not know they were going to be tested until they approached the museum exit. By using two separate, large random samples we have eliminated the possibility of pre-test influence on post-test score and have minimized the effects of individual variation among visitors.

Baseline testing took place from August 1 through October 30, 1975. Approximately 125 visitors per month took the slide test.[1]

[1] The testing period was unusually long due to interruptions as a result of museum Bicentennial construction. Under ordinary circumstances the testing could probably have been accomplished in a period of five weeks to two months.

FIG. 2

VISITOR TESTING STATION

FRONT VIEW OF TESTING MACHINE

FIG. 3

CARD PUNCHING MECHANISM

TAKING THE MUSEUM QUIZ

IV. RESULT OF BASELINE TESTING

A. Description of Sample Population

AGE[1]	Pre-Test (N=257)	Post-Test (N=242)	Total (N=499)
10 - 14	52	53	105 (21%)
15 - 24	111	93	204 (41%)
25 - 34	48	52	100 (20%)
35 - 49	31	28	59 (12%)
50 & over	15	16	31 (6%)
EDUCATION (Highest level achieved)	N=257	N=242	N=499
3 - 6	13	22	35 (7%)
7 - 9	49	38	87 (17%)
H.S.	63	80	143 (29%)
College	98	69	167 (33%)
Grad. School	34	33	67 (13%)
OCCUPATION	N=257	N=242	N=499
Scientists and Science Majors	86	75	161 (32%)
Others	171	167	338 (68%)
NUMBER OF VISITS	N=234	N=240	N=474
First	111	81	192 (41%)
Second	36	42	78 (16%)
Third-Fifth	33	43	76 (16%)
More than Fifth	54	74	128 (27%)

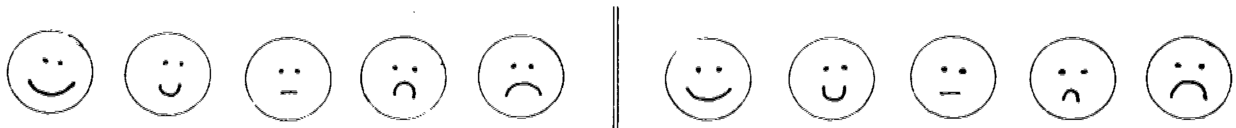
[1] Comparison with museum attendance (below) shows that the test sample is skewed toward the adult age groups. This is predictable, since in practice 10 years' old was the minimum age of persons tested.

Test Sample			Visitor Admissions
10-14		21%	39%
15-24		41%	23%
25-34	20%)		
35-49	12%)	38%	27%
50+	6%)		

B. Baseline Results of Affective Test

1. Attitude Toward the Museum

PRE-TEST | POST-TEST



PRE-TEST: 78% 20% 2% 0% 0% (98%)

POST-TEST: 66% 20% 12% 1% 1% (86%)

This rating scale shows a 12% decrease in positive feeling about the museum. Before the visit almost everyone has strongly positive feelings. Six times as many people are neutral about the museum after their visit. This sort of shift must be viewed with concern when it is realized that this 12% decrease corresponds to approximately 84,000 Franklin Institute visitors per year.

The result is no doubt due in large part to the fact that there was a great deal of construction and confusion in the museum during this period, with many exhibits and access areas closed down. An increase in visitor complaint letters occurred during this period.

On the other hand, it is theoretically possible that this change is in part a reflection of the change from anticipation of, to reaction to, the actual experience, with fatigue operating to further dampen post-test attitude scores. However, results of a second round of testing to measure the effectiveness of an experiment in visitor orientation (discussed in detail in Section V) indicate that this is not the case and that post-test attitude scores can be as high as pre-test scores if the museum makes a special effort to orient the visitor.

Our two other projective questions concerning the image of the museum do not show significant change from pre- to post- test and were found to be difficult to interpret. In response to a question about the appropriate audience for the museum, most visitors, both pre- and post-visit, felt that "There's something of interest for everyone" rather than that the museum's appeal is limited to a special group such as children or scientists.

An associational question revealed that the museum was seen to be most like a library or school as opposed to a theater, palace or circus. This supports the finding that visitors do come to the museum expecting to learn science.

2. Attitude Toward Science, Scientists and Technology

There is a slight but statistically significant negative shift in attitude from pre- to post-visit average score, but the post-test score is still strongly positive.[1]

Pre-Test	Post-Test	Change
75% ± 14	72% ± 15	- 3* p=.005

Thus, with regard to the goal of developing a positive attitude toward science and technology, we can see that the museum's audience is biased to be strongly positive.[2]

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[1] It will be remembered that scores above 50% are positive attitudes; scores below 50% are negative (see pp. 24-25).

[2] It would be interesting to administer the same attitude test to a sample of the general population outside the museum to learn the extent of the attitude differ e between visitors and nonvisitors.

*An asterisk will be used to denote statistically significant changes (i.e., all changes which are unlikely to have occurred by chance) based on t-test.

3. Attitude Sub-scales

The slight negative shift referred to above is seen in all sub-scales.

a. Interest in Science

Pre-Test	Post-Test	Change	
66% ± 24	63% ± 23	- 3*	p=.005

This is a combined score on five questions concerning visitors' interest in, and perception of, the importance of science as compared to other subjects. The fact that post-tested visitors are even slightly less interested in science is somewhat disturbing. Since the entering visitors are already highly interested in science, it is evident from these data that the problem is one of meeting visitors' expectations and maintaining rather than stimulating science interest.

b. Judgment of Science as Good or Bad

Pre-Test	Post-Test	Change	
79% ± 10	76% ± 10	- 3*	p=.005

Again, both scores are strongly positive, but the post-test score is slightly less so.

c. Perception of the Impact of Science on One's Daily Life

Pre-Test	Post-Test	Change	
78% ± 8	73% ± 9	- 5*	p=.005

This is the most negative finding. The largest affective change appears here. While still small, it is disturbing. It is an indication that the museum is not effective in moving its visitors closer to the subject matter of the exhibits, that more needs to be done to make the practical implications of museum displays clear to the visitors.

4. Subgroups (Demographic Variables)

Attitude scores might be expected to show some variation amongst various categories of visitors. Questions on a visitor's age, highest educational level achieved, interest in science and number of previous museum visits allow us to see the relation between these factors and test score.

AGE	Pre-Test	Post-Test	Change	
10-14	76	70	- 6*	p=.01
15-24	75	70	- 5	N.S[1]
25-34	77	73	- 4	N.S.
35-49	75	73	- 2	N.S.
50 & over	75	76	+ 1	N.S.
EDUCATION				
Grades 3-6	65	69	+ 4	N.S.
Grades 7-9	74	65	- 9*	p=.005
High School	75	73	- 2	N.S.
College	75	73	- 2	N.S.
Graduate School	80	73	- 7*	p=.01

The greatest attitude change is seen in the youngest group, 10-14 years old, and in grades 7-9. All other shifts are not significant with the exception of that observed in the most educated group (Graduate School). While the latter's score is still strongly positive, the negative shift for this group, reflecting a lesser enthusiasm after the museum visit, is not surprising in view of the fact that most exhibits are aimed at a much lower level.

[1] N.S. = "not significant" (statistically)

OCCUPATION

Visitors were asked whether they consider themselves scientists, actual or potential science majors, or nonscientists. As might be expected, attitudes of the "scientist" group were more positive, both pre- and post-visit, than those of nonscientists. Neither group showed a statistically significant attitude shift.

	Pre-Test	Post-Test	Change	
Scientists	82%	80%	- 2	N.S.
Nonscientists	72%	68%	- 4	N.S.

NUMBER OF VISITS TO THE MUSEUM

First Visit	74%	72%	- 2	N.S.
Second Visit	76%	68%	- 8*	p=.005
Third-Fifth Visit	78%	72%	- 6*	p=.025
More than Fifth	79%	73%	- 6*	p=.025

The direct correlation on the pre-test between attitude score and number of visits indicates simply that the people who are more strongly positive come back more often. Of note on the post-test is the dip in post-test score on the second visit. This is also seen in the pattern of scores on the cognitive test. The reason for it is not clear. It might be a function of the social circumstances of the second visit. For example, people may be returning to show the museum to friends. The novelty has worn off, but they are not yet among those who have really gotten "hooked" by the museum (see p.41).

Again, the generally negative shift in attitude which appears on almost <u>every</u> question, particularly for those not visiting for the first time (i.e., 60% of visitors) is probably a reflection of the confusion and disorder associated with Bicentennial-related construction taking place during the testing period and the fact that visitors returning to the museum had higher expectations and were disappointed. This means that attitudes toward the museum itself have influenced attitudes toward science, technology and scientists.[1] It is important in that it suggests that the general gestalt of the building will influence the communication of exhibit content. This point will be reinforced later in the discussion of an experiment with visitor orientation.

C. Baseline Results of Cognitive Test

The results of the cognitive test show a clear increase in score from pre- to post-visit test. Average scores are:

Pre-Test	Post-Test	Change	
36% $\pm$ 12	54% $\pm$ 17	+ 18*	p=.001

While the post-visit score may appear to be low (by school test standards), it represents a statistically significant increase over pre-test scores and suggests that the average "casual" visitor leaves the museum knowing over half of the tested information content of the exhibits. As we are dealing here w[illegible]sual visitors whose primary goal is entertainment and who spend only two or three hours in the museum,[2] it is noteworthy that this much information transfer does occur.

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[1] If the negative shift were indicative only of a change in attitude toward various aspects of science and technology, we would expect greater variation from question to question. Instead, we see a strikingly uniform decrease from pre- to post-test.

[2] See "typical visit," p. 59.

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1. Cognitive Sub-scales

The quiz consists of three types of questions, representing a hierarchy of levels of learning. Pre- and post-test scores are given below:

	Pre-Test	Post-Test	Change	
Vocabulary	33%	54%	+ 21*	p=.001
Experience	35%	47%	+ 12*	p=.01
Concept Formation	43%	63%	+ 20*	p=.001

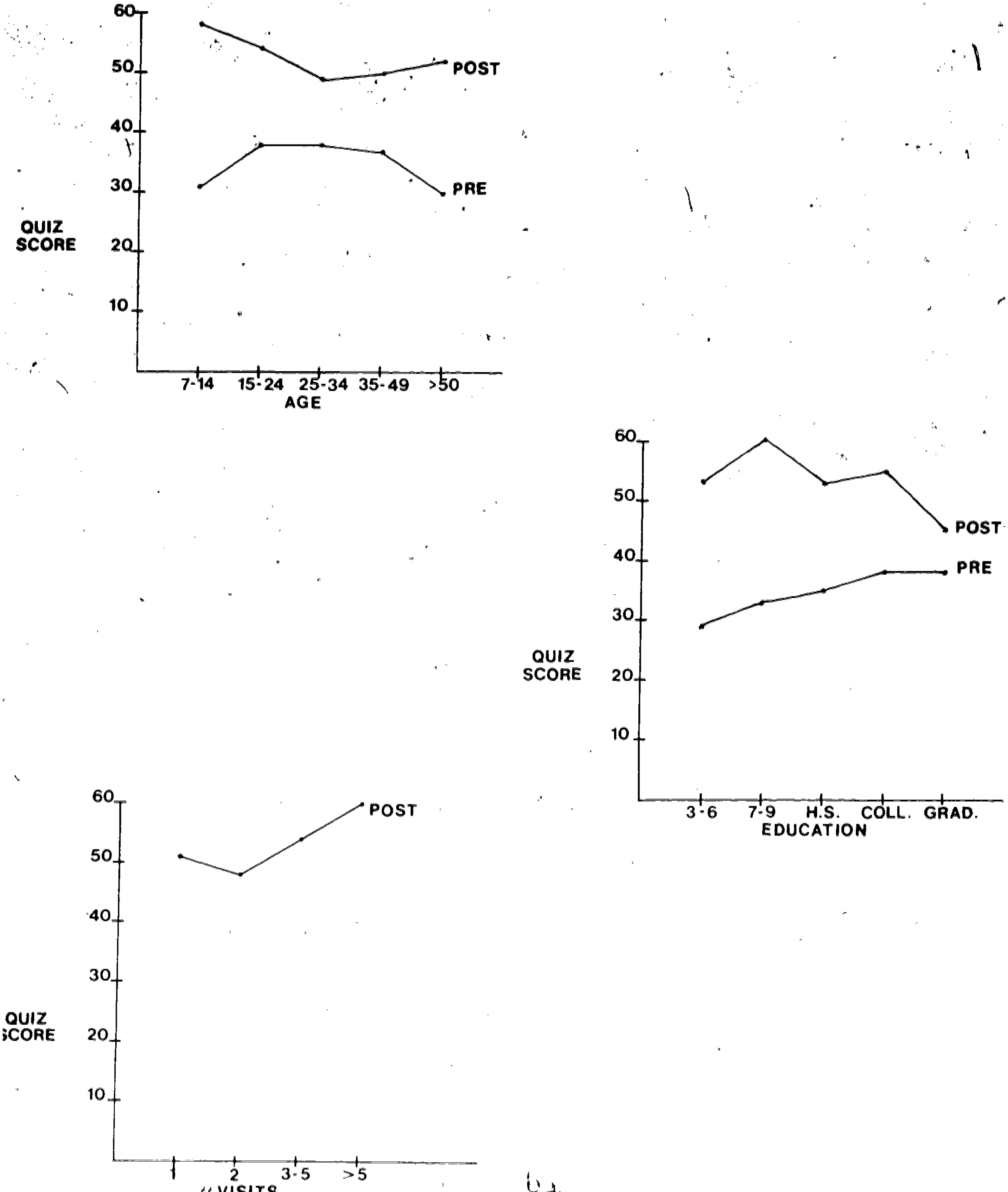
All of the above show significant increases. It is interesting that the highest increases are in vocabulary and concept learning, with a lower increase on the experience sub-scale, which is based on direct participation. This difference may be due in part to the nature of the testing procedure, which, although making use of visual stimuli and push-button response, did present written questions and answers as opposed to requiring a behavioral demonstration. The latter might have yielded better results in testing learning by direct experience.

2. Subgroups (Demographic Variables - See Figure 4)

Another way to look at quiz scores is in terms of the amount of increase shown by various categories of visitor.

AGE	Pre-Test	Post-Test	Change	
10-14	31%	58%	+ 27*	p=.001
15-24	38%	54%	+ 16*	p=.001
25-34	38%	49%	+ 11*	p=.025
35-49	37%	50%	+ 13*	p=.01
50 & over	30%	52%	+ 22*	p=.001

FIG. 4 QUIZ SCORE × SUB-GROUP



EDUCATION (highest level achieved)	Pre-Test	Post-Test		
Grades 3-6	29%	53%	+ 24*	p=.001
Grades 7-9	33%	60%	+ 27*	p=.001
High School	34%	53%	+ 19*	p=.001
College	38%	55%	+ 17*	p=.001
Graduate School	38%	45%	+ 7	N.S.

We can see that both the highest increase and highest absolute score are found in the youngest age group. In addition, while there is a positive correlation between education and score on the pre-test, this is not true of the post-test, where children in grades 7-9 score higher than college students and those in graduate school. Clearly, elementary school children are absorbing a significant amount of exhibit content during a museum visit. This is a strongly positive finding, since this is the target audience toward which museum exhibits are aimed. Further, elementary school children are a large segment of the visitor population. This data supports the notion that museums can serve as adjunct learning institutions which supplement the classroom and other educational media.

The lowest increase is found in the 25-34 year age group. This group includes many parents who presumably see themselves as coming to the museum for the benefit of their children and probably spend much of their time supervising the children rather than attending to the exhibits.

OCCUPATION

Scores of "scientists"[1] were somewhat higher than those of "nonscientists" on both the pre- and post-visit tests, but the amount of increase is similar.

	Pre-Test	Post-Test	Change	
Scientist	42%	58%	+ 16*	p=.001
Nonscientist	34%	52%	+ 18*	p=.001

This is interesting in that it indicates that <u>the museum does reach a general audience</u> and is not simply communicating with subgroups of scientists and would-be scientists.

NUMBER OF VISITS	Post-Test
First Visit	51%
Second Visit	48%
Third-Fifth Visit	54%
More than Fifth Visit	60%

We can see that, with the exception of the second visit, quiz scores increase with visits. The dip in the second visit noted on the attitude test may be due to a variety of factors such as: showing the museum to someone else, visiting only what was missed on the first visit, or concentrating only on a few favorite exhibits.

3. Instructional Effectiveness of Exhibits

The average score for those exhibit halls on which visitors were tested appear below, listed in order of instructional effectiveness.

[1] The term "scientists" applies to people who identify themselves as scientists or science majors.

"Effectiveness" is based here on the amount of increase from pre- to post-visit:

	Pre-Test	Post-Test	Change	
Math	34%	57%	+ 23*	p=.001
Electronic Music	33%	55%	+ 22*	p=.001
Energy	28%	48%	+ 20*	p=.001
Ships	47%	62%	+ 15*	p=.005
Printing and Papermaking	48%	60%	+ 12*	p=.01

Note that the highest post-test scores are in areas where visitors have the highest pre-test scores (Ships, Printing). This probably reflects the more familiar, less conceptual nature of the material in these exhibits and may indicate a "ceiling effect" in museum-based learning.

D. Evaluation of Cognitive-Affective Test

The cognitive-affective test has generated a considerable amount of information about the effect of a museum visit on the visitor population and its component subgroups. The cognitive section provides a measure of museum-based learning and indicates variation in the instructional potential of different exhibits. On the other hand, the test of attitudes toward scientists, science and technology proved to be too long and detailed for the amount of information it yielded. It is interesting to find out that visitors are strongly biased in favor of science; but since question by question there is not sufficient patterned variation to give us a more detailed analysis, it seems that one or two questions per subscale would have sufficed. On the other hand, it would be worthwhile to use the full test in a study in which responses of museum visitors were compared to those of the general public.

The rating scale ("Faces Test," see p.100) concerning general feeling about the museum gives an easily interpretable measure of visitors' reaction. Two additional projective questions give us an indication of the museum's image. However, since (unlike the "Faces Test") there is no difference between pre- and post-visit response to these associational questions, they would be more appropriate in a questionnaire rather than on a test designed to measure the immediate impact of a visit.

Answers to questions about a visitor's age, educational background, interest in science and number of previous visits were interesting in terms of correlations with attitude and quiz scores. This section of the test could be expanded to deal with additional variables such as occupation, economic level, place of residence, etc.

V. ORIENTATION

A. Background

The orientation of visitors to the structure and contents of the museum is an important aspect of the visit and one which is often low on the list of priorities of the museum staff. Robert Lakota (1975) in a study of visitor response, conducted at the National Museum of Natural History, found that low scores on an exhibit identification test were associated with points of spatial and subject matter confusion. In other words, apparently people aren't receptive to information if they are feeling lost. Another problem is that of underused areas. In a multi-story museum, the highest concentration of visitors is on the entrance floor. At the Milwaukee Public Museum, which has three stories, visitors begin at the bottom and move up. Less than half get to the third floor (Borhegyi, 1968). Large museums face the additional problem of "museum fatigue"; people try to see too much in one visit. They hurry through the museum and end up spending a shorter period of time at individual exhibits.

A preliminary analysis of visitor orientation at The Franklin Institute revealed that this was a major problem area. Information was gathered through brief interviews with members of the museum staff who come most directly into contact with the visitors: guards, elevator operators, cashiers, floor demonstrators and museum volunteers. A small sample of visitors was tracked (followed) around the museum to discover walking paths, key choice points, and underused areas. Finally, a questionnaire dealing specifically with orientation was distributed to a sample of 216 visitors (see Appendix B, pp. 85-86).

As a result of these inquiries, it was found that the structure of the building did present problems to the visitor (see Map, Appendix B, p.87) making the visit somewhat less satisfying and instructive than it might otherwise by. People reported particular difficulty in locating service facilities. Signing in the building was sparse, and most directional signs were dimly lit and well above eye level. Another problem is presented by the intrinsic "peculiarity" of The Franklin Institute Museum building, which was originally designed to be bilaterally symmetrical but never completed.

The floor-plan brochure distributed to all visitors when they entered the Museum was found to be functioning well to assist people in locating exhibits. However, many visitors seem to need to verify the information they get from printed material by consulting with guards or demonstrators. In addition to foreign visitors and youngsters who cannot read, many people often have difficulty relating to printed information and require verbal instruction. Guards and demonstrators are burdened by other responsibilities and may not understand the visitor's need to verify or receive verbal information. It would appear that there is a genuine need for a special staff person or persons, located close to entry points, whose primary responsibility is orientation.

The questionnaire revealed that the itinerary of a museum visit is usually unplanned. Visitors wander until they find an interesting exhibit; they generally try to see everything in the building in their 2-3 hour visit. This is probably the least rewarding way to see a museum. The number and duration of stops tend to diminish as the visit progresses, and people may never get to exhibits and demonstrations they might really enjoy. In this connection an interesting discovery was made. Most visitors reported seeing the whole museum floor by floor; however, it was found that half the visitors were missing the top floor. Apparently the European floor-numbering system of THIRD, SECOND, FIRST and GROUND confused visitors and suggested to many people that there are only three instead of four exhibit floors. The fact that the main stairwell ends at the second floor reinforced the notion that Ground=First, First=Second and Second=Third.

B. Changes in Orientation

Following these baseline studies a number of important changes were scheduled:

1. New directional, floor number, exhibit and service facility signs.
2. A change in floor numbers to FOURTH, THIRD, SECOND and FIRST.
3. Cross-sectional floor-plan maps mounted on the walls so that people can see where they are in relation to exhibits and facilities.
4. An information desk staffed full time by a person whose main function is verbal guidance.
5. Experimental orientation material designed to provide some minimal structure to the sequence of a visit.

C. Orientation Experiment

The term "orientation" as used here is broadly defined to encompass an experiment in minimal instructional programming - a teaching experiment using an adjunct system (such as a question sheet) to provide some control over a) order of visit, b) motivation and c) focus of attention.

There has been much experimentation in the museum field in the use of adjunct materials to enhance the teaching effectiveness of exhibits. These range from a simple map and guide sheet to sophisticated hardware (Screven, 1976).

Recent efforts in this area have involved the structuring of exhibits as planned learning sequences, producing a highly structured museum visit. The extreme case is the work of Nicol (1969) at the Boston Children's Museum, where an entire exhibit was planned, set up and evaluated as a controlled learning sequence. A carefully controlled learning experience can produce good performance on cognitive tests. However, it is important to determine whether museums can achieve their cognitive and affective objectives without rebuilding their exhibits and completely controlling the shape of a museum visit. This was the aim of the second phase of the pilot study. The operating hypotheses for this experiment in orientation were:

> *Visitors need an orientation place at which they can stop after entering the building, and where they are encouraged to make conscious choices about what they want to see and how much time they want to spend in the museum. Short orientation brochures and maps of [illegible] tours tailored to specific interests, [illegible] amounts of time available will allow visitors to make informed choices and set attainable goals. [illegible] orientation should translate into higher scores on [illegible]-affective museum tests.*

Three experimental handouts were prepared (see Appendix C):

1. "Highlights Tour" -

   recommends a sequence of exhibits to first-time visitors, especially those who have only a short time to spend in the museum.

2. "Search and Discover" -

   is a question game for parents and young children (recommended ages 5-10). This booklet consists of: an explanation to parents, a detachable question sheet for children, an answer sheet with further information and reading references, and an evaluation form. Questions are simple and non-label based, emphasizing what children see and do in the exhibits. Children who have filled in all of the correct answers (checked by the parents) receive a Franklin Institute Certificate signed by the Museum Director.

   The purposes of the "Search and Discover" game were: to give the visit a focus, involve parents, help them with the role of "expert" in which they find themselves, and encourage pursuit of further information after the visit.

3. The "Museum Adventure Trail" -

   is a quiz sheet similar to "Search and Discover," but with more challenging questions for older children, teenagers and interested adults. Answers are posted at the information desk. The reward for correctly completing the "Adventure Trail" is a coupon for a 10% discount at the museum gift shop.

These orientation materials were not distributed to all visitors. Rather, the volunteers staffing the Information Desk were instructed to suggest them to appropriate categories of visitors. The notion of "suggesting" these materials to the visitor is important; as early as 1940 William E. Kearns, in a study at the Peabody Museum at Yale University, demonstrated that piles of printed orientation material are relatively ineffective unless there is a person present to suggest their use and verify visitors' understanding of the material.

D. Retesting Visitors

Ideally, visitors should have been retested after the new signs, floor numbers, maps and Information Desk had been installed, with all other facets of the museum remaining stable. In practice this pilot project was conducted during a year of extensive construction and renovation in preparation for the Bicentennial. Since so much of the building had been altered, the baseline data could not be used as a measure of visitors' response to the museum at the time of the orientation experiment. Consequently, in evaluating the effect of the orientation materials, we have had to compare the post-test scores of a sample of 250 visitors who used one of the three items to scores of a new control group of 250 post-tested visitors who had not used any of the materials (retest group), rather than simply making a comparison to scores from the baseline post-test.

1. Affective Retest

The effects of construction and renovation in the museum showed up on the retest as a further decrease in visitors' affective scores:

	Baseline Pre-Test	Baseline Post-Test	Retest (Post-Test Only)
Attitude toward Science, Scientists, Technology	75% ± 14	72% ± 15	68% - 7* p=.001
Highly Positive Feelings about the Museum[1]	78%	66%	64% -14* = 18% decrease

2. Orientation Materials

a. "Highlights Tour" Sheet

The goals of the tour sheet were:

(1) To improve learning scores and attitude toward the museum by directing visitors toward completed exhibits, thus decreasing the amount of time spent wandering,

(2) To show particular increases for first-time visitors and for the adult age range.

Results of the retest show no significant improvement in general quiz score or in attitude. While adults do show a slight improvement in quiz scores, first-time visitors' scores decreased:

WHOLE SAMPLE	Retest Control	Highlights Tour		
Quiz	55%	56%	+ 1	N.S.
Science Attitude	68%	69%	+ 1	N.S.
Highly Positive Feelings about the Museum	64%	62%	- 2	N.S.
FIRST-TIME VISITORS				
Quiz	54%	48%	- 6	N.S.
Science Attitude	69%	65%	- 4*	p = .001

[1]Figures indicate percentage of visitors selecting large smile as representative of their feelings about the visit (see p.100).

Clearly, the "Highlights Tour" sheet is not an effective orientation device.

b. "Search and Discover" Game

This game sheet was designed for parents and young children. Since these children were too young to be tested, we cannot look at their scores. But we did expect increases in the cognitive and affective test scores of the age group containing parents of young children (25-34).

	Retest Control	Search and Discover		
Highly Positive Feelings about the Museum	64%	[illegible]		[illegible]
Quiz Score:				
25-34	55%	59%	+ 4	N.S.
35-49	50%	no cases		
Science Attitude:				
25-34	67%	72%	+ 5*	p= .001
35-49	67%	no cases		

We see that feelings about the museum are more positive, and that attitude and to some extent quiz scores have increased in the 25-34 age group.

Visitors' Evaluation

Most parents did not turn in the tear-off evaluation sheet attached to the "Search and Discover" game. On the 61 sheets returned the evaluation was strongly positive:

59 (97%) liked it

2 (3%) didn't like it

61 (100%) reported that their children liked it

Comments which appeared on the sheets are listed below:

"Terrific idea, especially for a group of school children."

"More questions!"

"Very enjoyable, museum seemed very warm - but nonetheless exciting."

"Very much enjoyed."

"Good idea - like a treasure hunt."

The children enjoyed it very much."

"Girl Scout Group - age 12-13. A very good device for seeing every display. Like a treasure hunt. Thanks. Not easy."

"It was hard to find some things but we all think it was a great idea."

"I found myself seeking out particular information which enhances my learning and my powers of observation."

"Marvelous idea. It really encourages the children to see the museum - even though it may rush the adults."

"The children loved the museum - even the 2½ year old."

"More difficult questions. Even my 4 year old had no difficulty."

"Very helpful!"

"We enjoyed this very much."

"This made our visit more fun - wish we had all day to cover everything."

"It would be a good idea to have something like this all the time. It gave us a sense of purpose while going through. Thanks."

"No suggestion - just great idea."

"Too much for Mother to do but is a good idea."

"This was a good idea. It shows you how much you remember and really learn while touring the Institute."

c. "Museum Adventure Trail"

This self-quiz sheet was directed to ages 1[illegible] through adult and was designed to improve cognitive scores and attitude toward the museum.

WHOLE SAMPLE	Retest Control	Adventure Trail		
Quiz	55%	59%	+ 4	p = .05
Science Attitude	68%	63%	- 5*	p = .001
Highly Positive Feelings about the Museum	64%	78%	+14*	= 22% increase
QUIZ SCORE X AGE				
10-14	51%	54%	+ 3	N.S.
15-24	59%	66%	+ 7*	p = .05
25-34	55%	67%	+12*	p = .05
35-49	50%	57%	+ 7*	p = .05
50 & over	60%	no cases		

Note that attitude toward the museum is a great deal more positive and that quiz scores have increased for all age groups. Clearly, a self-quiz is an effective adjunct to museum exhibits.

d. Summary

Scores of visitors using the orientation materials show that "Search and Discover" and "Adventure Trail" are effective whereas the "Highlights Tour" is not. This experiment in orientation demonstrates a number of points:

(1) A fall in post-visit attitude toward the museum is not a necessary concomitant of the end of a visit.

The Adventure Trail users were as positive as baseline pre-test visitors.

(2) Visitors enjoy a self-administered quiz and such a device stimulates museum-based learning.

(3) The pilot study has developed a test instrument and procedure which is useful in evaluating changes in museum operations.

VI. PROCESS OF VISIT

A. Attendance

The most direct way to measure the "attracting power" of an exhibit is to count the number of visitors attending the exhibit during a specified period of time. This figure can then be converted to a percentage of the total number of visitors in the museum in this time period and compared to percentages attending other exhibit halls.[1]

A floor-plan map of the building (see Appendix B) with exhibit hall names was distributed to a sample of 150 visitors. These visitors were asked to trace their route through the museum and to indicate exhibits which they "stopped to look at." This questionnaire enabled us to determine: general traffic flow patterns, effects of entrance used on the path of a visit, population density in different parts of the building, attendance on the different floors, and well and poorly attended exhibits. The same questionnaire also provided information on the number of exhibits attended by each visitor. The latter data, combined with figures on amounts of time spent in the museum, allowed us to arrive at the number of exhibits seen during a "typical visit" and the average amount of time spent per exhibit.

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[1] Our count here is based on visitors' reports of exhibits attended rather than on observers' counts of individuals entering an exhibit hall. Since some of our exhibit halls function as corridors to other exhibits, visitors would have to be timed and determined to have spent more than some minimum amount of time in order to be counted as having "attended" an exhibit. To circumvent this problem we have used visitors' own reports of exhibit attendance.

1. Floor Attendance

Attendance in exhibit halls at The Franklin Institute reflects not only the popularity of the exhibit but also its location in the building - its accessibility.

Only one half of the visitors reach the top floor:

Floor Number	Percentage of Visitors
3	54%
2	94%
1	96%
Ground	97%

The high percentages on Floors Ground-2 can be explained by the presence of entrances on the ground and first floors and by the fact that the large pendulum stairwell takes visitors to Ground, 1 and 2 but does not reach the 3rd floor.

2. Exhibit Attendance

In interpreting attendance in exhibit halls, we have compared the number of visitors to the hall to the number on that floor of the building. Our index of the "attracting power" of an exhibit is:

$$\frac{\text{\# of visitors in this hall}}{\text{\# of visitors on this floor}} \times 100$$

The following is a list of exhibits ranked according to attracting power. The percentage of total museum attendance is also given in order to indicate which halls are actually underused.

EXHIBIT ATTENDANCE

		Floor Number	% Floor Attendance		% Total Attendance
1.	Energy	2	88%	GOOD	82%
2.	Ships	2	88%		83%
3.	Aviation	1	87%		80%
4.	Math	3	82%		44%
5.	Trains	G	80%		78%
6.	Collector's Gallery	3	75%		41%
7.	Physics	2	63%	MODERATE	59%
8.	Heart	1	58%		56%
9.	Hall of Illusions	2	58%		55%
10.	Beauty in the Universe	3	54%		29%
11.	Symmetry	2	45%	LOW	43%
12.	Observatory	3	42%		23%
13.	Franklin Hall	1	41%		41%
14.	Autos	G	40%		39%
15.	Ben's Shop	G	40%		39%
16.	Electromagnetic Spectrum	G	39%		38%
17.	Printing	G	37%		36%
18.	Planetarium[1]	G	34%		33%
19.	Apollo	G	22%	VERY LOW	22%
20.	Mirrors of America	1	13%		12%

[1] The Planetarium's low density is explained by the fact that it has limited seating capacity, scheduled performances, and an additional admission charge.

B. Entrances

The Franklin Institute has two entrances. An imposing main entrance leads to a grand lobby on the first floor. A secondary entrance on another street leads to the ground floor Planetarium entrance (see Map, Appendix B). The most significant difference in the pattern of visits set up by the two entrances is that in cold weather visitors using the side entrance tend to carry their coats, since the main coat check is at the other entrance and an auxiliary checkroom is not clearly visible. Very few of these side-entrance visitors ever get to the free Sound and Light Show in the Benjamin Franklin National Memorial (see Map, Appendix B), since they have to exit from the paid museum area in order to see the show. They must show their admission ticket stubs in order to re-enter.

C. Time Spent - A "Typical Visit"

From our data on exhibit attendance and amount of time spent in the museum, it appears that there are two types of "typical" visit (see Figures 5 and 6).

Time Spent	Number of Exhibits Seen
Short Visit, 2 hours	9-11
Long Visit, 3-3½ hours	14

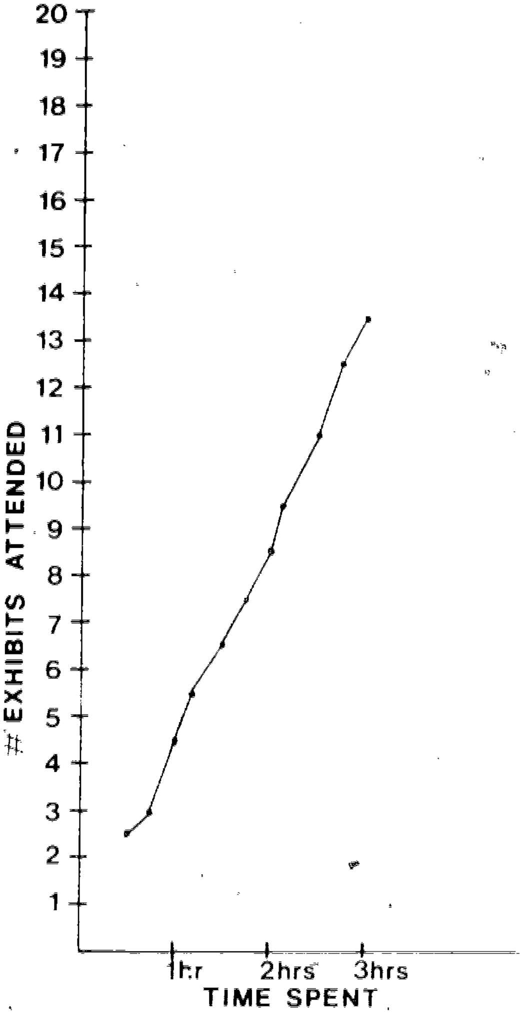
Viewing times for exhibit halls and displays can also be calculated:

Average time per exhibit hall	= 12 minutes
Average number of displays per hall	= 23 displays[1]
Average time per display	= .52 minutes (31 seconds)[2]

[1] For a definition of "display,' see p. 64.

[2] This is consistent with the findings of previous researchers (see Parsons, 1968, pp. 91-92, and Shettel, 1973, p. 38) who found that visitors spend 40 seconds or less at each display.

FIG. 5 #EXHIBITS × TIME



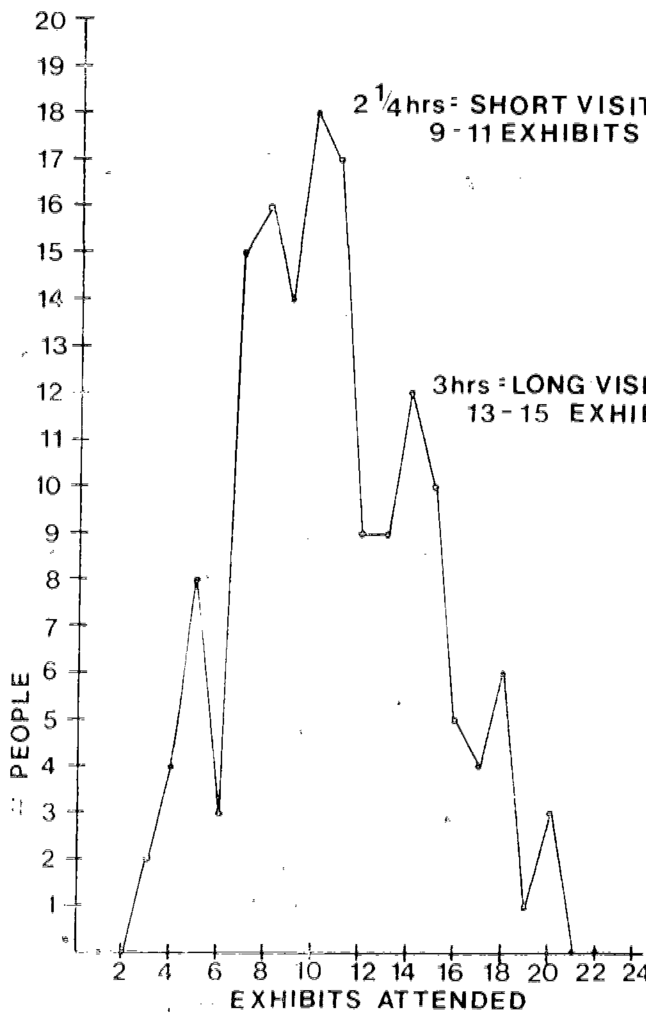


FIG. 6 STANDARD VISITS

It is interesting to note that we found no difference in the length of a visit and number of exhibits seen between the winter and spring seasons or between visitor groups using the two different museum entrances.

D. Visitors' Preferences

Harris Shettel (1968) proposed a tripartite measure of exhibit effectiveness: attracting power, holding power (average time spent at the exhibit) and teaching effectivenes. We have discussed both attracting power (attendance) and teaching effectiveness (quiz score). With regard to holding power, rather than determining the average amount of time spent in the exhibit hall, we have substituted the variable "popularity."

A questionnaire (see Appendix B) was distributed to a sample of 115 visitors, who were asked to indicate whether they liked, disliked, or didn't see each of the exhibits listed. The percentage of people who liked and disliked each of the exhibits was determined. The percentage of visitors who disliked an exhibit was then subtracted from the percentage who liked the exhibit, and the resultant score was rank ordered to give us the following list of exhibits in order of popularity:

EXHIBIT	RANK	% LIKE	% DISLIKE	LIKE - DISLIKE
Energy	1	90	2	88
Trains	2	88	4	84
Aviation	3	86	5	81
Hall of Illusions	3	89	8	81
Physics	4	88	10	78
Ships	5	81	11	70
Heart	6	82	14	68
Mirrors	7	78	13	65
Observatory	8	74	10	64
Math	9	77	14	63
Franklin Hall	10	69	10	59
Electromagnetic Spectrum	11	71	14	57
Beauty in the Universe	12	69	19	50
Collector's Gallery	13	66	17	49

E. Exhibit Effectiveness

In the following table, we have ranked museum exhibits on the basis of data on attendance (R1) and popularity (R2) and then averaged the two to give an effectiveness rating (R3). In the column on the far right, the rank order for the instructional power of the six exhibits for which the cognitive test was given is listed.[1]

[1]Had more of the exhibits in the museum remained constant during the period of testing for this pilot study, a greater number would have been included in the cognitive test, in which case our final "effectiveness" score could be based on instructional power as well.

EXHIBIT EFFECTIVENESS

EXHIBIT	EFFECTIVENESS	R3	ATTRACTING POWER (% FLOOR ATTENDANCE)	R1	POPULARITY (% LIKE-DISLIKE)	R2	INSTRUCTIONAL POWE (POST-TEST SCORE - PRE-TEST SCORE)*	
Energy	88	1	88	1	88	1	+20%	2
Aviation	84	2	87	2	81	3		
Trains	82	3	80	4	84	2		
Ships	79	4	88	1	70	5	+15%	4
Electronic Music	79	4	79	5	--	--	+22%	3
Math	73	5	82	3	63	9	+23%	1
Physics	71	6	63	7	78	4	+12%	5
Hall of Illusions	70	7	58	8	81	3		
Heart	63	8	58	8	68	6		
Collectors Gallery	62	9	75	6	49	13		
Franklin Hall	55	10	51	11	59	10		
Observatory	53	11	42	10	64	8		
Beauty in the Universe	52	12	54	9	50	12		
Electromagnetic Spectrum	48	13	39	12	57	11		
Mirrors	39	14	13	14	65	7		
Printing & Papermaking	37	15	37	13	--	--	+12%	5

*Cognitive test given for six exhibits only.

VII. EXHIBITRY

Now that we have discovered what the visitors see, how they get there, what they learn and what they like, we would like to know why some exhibits are more "effective" than others, i.e., the elements of which a good exhibit is composed. To answer this question experimentally rather than intuitively would require many studies using experimental exhibits varying only one or a small number of selected features at a time. An example of such a study is one done by Laurie Eason and Marcia Linn (1975) at the Lawrence Hall of Science in Berkeley, California. Eason and Linn found that both visitor-operated demonstration machines and open-ended activity booths "are effective exhibit methods for presenting scientific principles" (p. 27). Another pioneering study was done by Lee A. Parsons (1968) at the Milwaukee Public Museum. Parsons set up a series of exhibits to test three characteristics:

a. Kind and quality of labeling

b. Degree of visual complexity

c. Use of color as a visual aid

Visitors were tested to determine the success of the exhibit in:

a. Communication

b. Education

c. Entertainment

Parsons found that visitors favor:

A. More detailed labeling

B. A declarative or didactic vs. question approach to labeling

C. Complex (i.e., many specimens) vs. simple display

D. Limited use of color

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He concludes that "organized clutter" and emphasis on specimens instead of color background have greater appeal to natural history museum visitors.

In the absence of experimental displays set up specifically to determine effectiveness, we have made a rough calculation of the effect of two of Parsons' factors - degree of visual complexity and use of color - on the attracting power, instructional power and popularity of existing museum exhibits, using our data on exhibit attendance and popularity and cognitive test scores. In addition, we have examined the effects of participation through pushbuttons and other devices on visitor response.

A. Complexity

To get a rough measure of the complexity of individual exhibition halls, we have looked at the number of displays in the hall.

A "display" is here defined as: an enclosed glass case, a participatory device, or a panel or set of panels concerning a single topic and having uniform design treatment. "Display" is by no means a clearly defined variable since, especially in the case of panels, it is frequently difficult to find the boundaries of a display. Nevertheless, since we lack a clearer unit, we have counted the number of displays and observed the following (see Figure 7):

Visitors prefer the more complex exhibit halls, having 30-40 displays per room, as opposed to the halls having sparser, more contemporary display style.

There is a significant and positive correlation between number of displays and percentage of visitors liking the exhibit (r=+55, p=.05).

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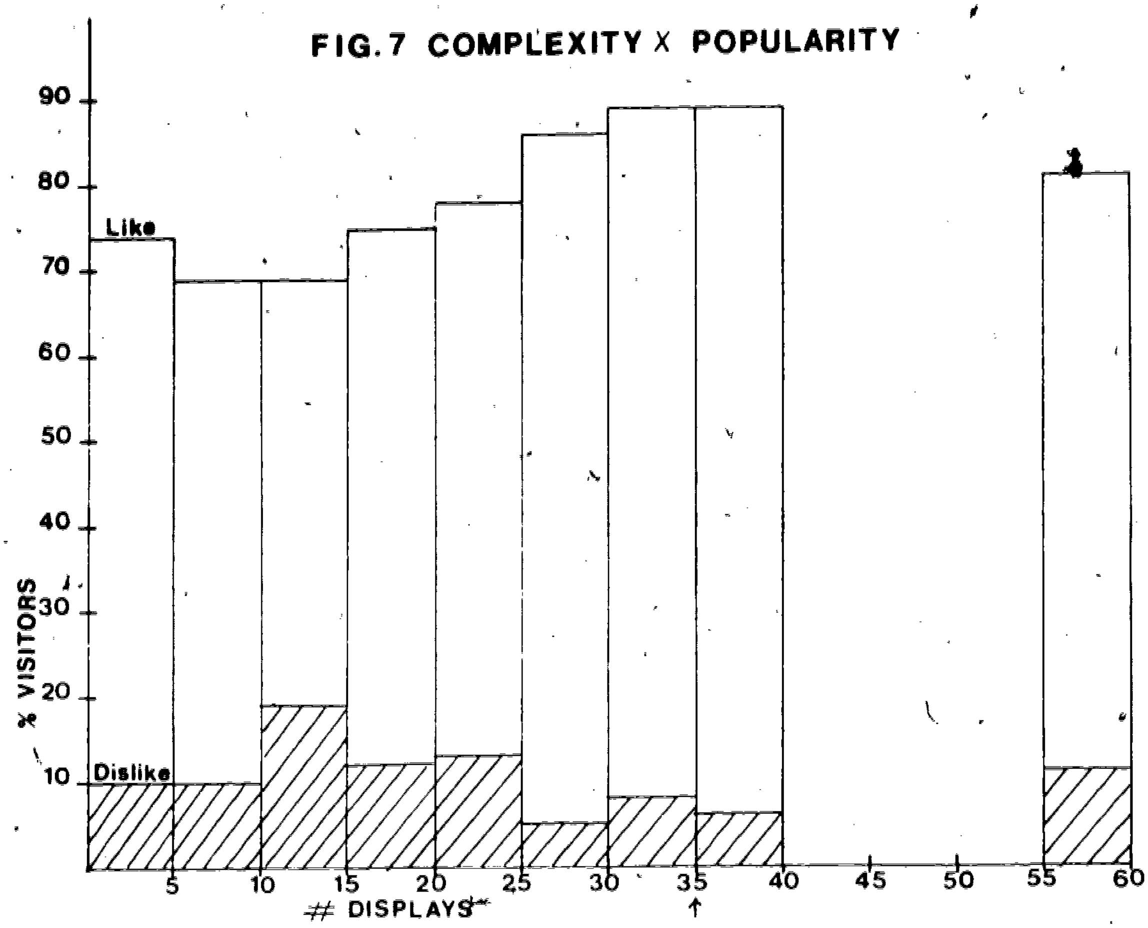
FIG. 7 COMPLEXITY X POPULARITY
90
80
70
60
50
40
30
20
10
% VISITORS
Like
Dislike
5
10
15
20
25
30
35
40
45
50
55
60
DISPLAYS

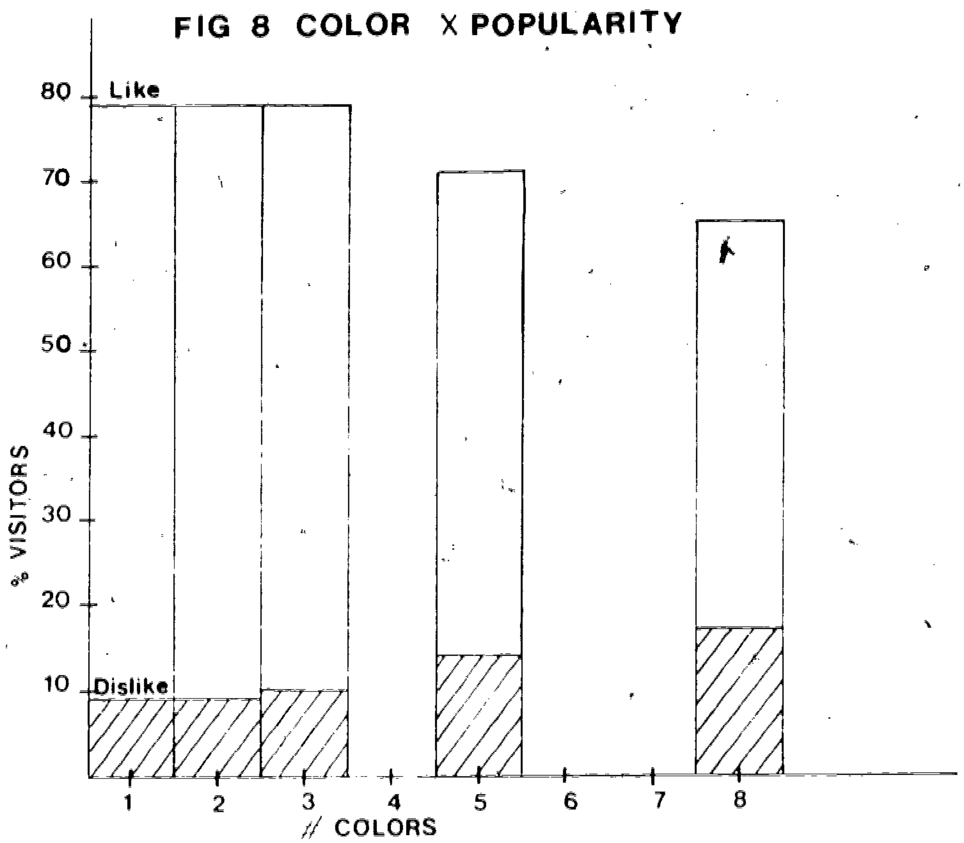
FIG 8 COLOR X POPULARITY
80
70
60
50
40
30
20
10
% VISITORS
Like
Dislike
1
2
3
4
5
6
7
8
COLORS

B. Background Colors

As the number of background colors increases, the percentage of visitors who dislike the room increases. That is:

There is a negative correlation between popularity and number of background colors ($r = -.53$, $p = .05$) (see Figure 8).

C. Popularity vs. Attracting Power

It is to be noted that the number of displays and background colors affects the "popularity" of an exhibit hall but not its "attracting power". There is no significant correlation between these variables and visitor attendance (either floor attendance or percent of total museum attendance).

D. Participation

We were interested in observing the impact on the visitor of direct interaction with exhibits. "Participatory devices" are generally thought to be more effective than static exhibits in attracting and holding visitors' attention and communicating content (Thier, 1975). Participatory device is here defined as anything which the visitor can change through direct handling, or a large structure which the visitor walks or climbs on, into or through ("climb-on").

Our data shows a direct correlation between popularity and number of participatory devices per room ($r=+.69$, $p=.01$).[1]

[1] When we look at popularity and the density (as opposed to the number) of participatory displays (i.e., square feet of exhibit space divided by number of participatory displays in the room) we see a slightly weaker but still positive correlation ($r = +40$) which is not significant given this limited sample. Consideration of popularity and the percent of participatory displays as opposed to static dislpays in a hall gives an even weaker correlation ($r = +36$).

However, we also see that there is a strong inverse correlation between instructional power and number of participatory devices (r=-.99, p=.05). (See Figure 10.)

Since the latter is based on a sample of only four exhibit halls, we may be seeing the effects of particular forms of participatory device as opposed to the category "participatory devices" in general.

However, if we separate button-pushing from other participatory devices, we see that:

Pushbuttons account for most of the negative correlation with instructional power (r=-.92, p=.05).

Pushbuttons are frequently only start buttons and don't allow real interaction with the display. They do not help visitors to perceive significant cause and effect relationships.

In terms of popularity, both pushbuttons and other participatory devices correlate positively with the percentage of visitors liking the exhibit hall (r=+.50 and +.58 respectively).[1]

We conclude from the above that pushbuttons seem to hinder rather than help the communication of scientific facts and principles.

Successful participatory learning devices allow visitors to manipulate objects in their environment to conduct experiments to explore the effects of variation and observe the results.

[1]All of the correlations in this section are based on a small sample of exhibits. In order to be really certain that the relationships observed are not simply true of the limited group of exhibits studied here, it is necessary to conduct a comparative study in a sampling of science museums to generate a sufficiently large and diverse data base (see pp. 75-6).

Yet pushbuttons, found with great frequency in many science museums, do appeal to visitors. They can be effectively used in introductory and transitional areas of an exhibit to attract visitors' attention and involvement; but the push button alone is not effective in areas where conceptual content is to be conveyed.

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FIG. 9 ACTIVITY X POPULARITY

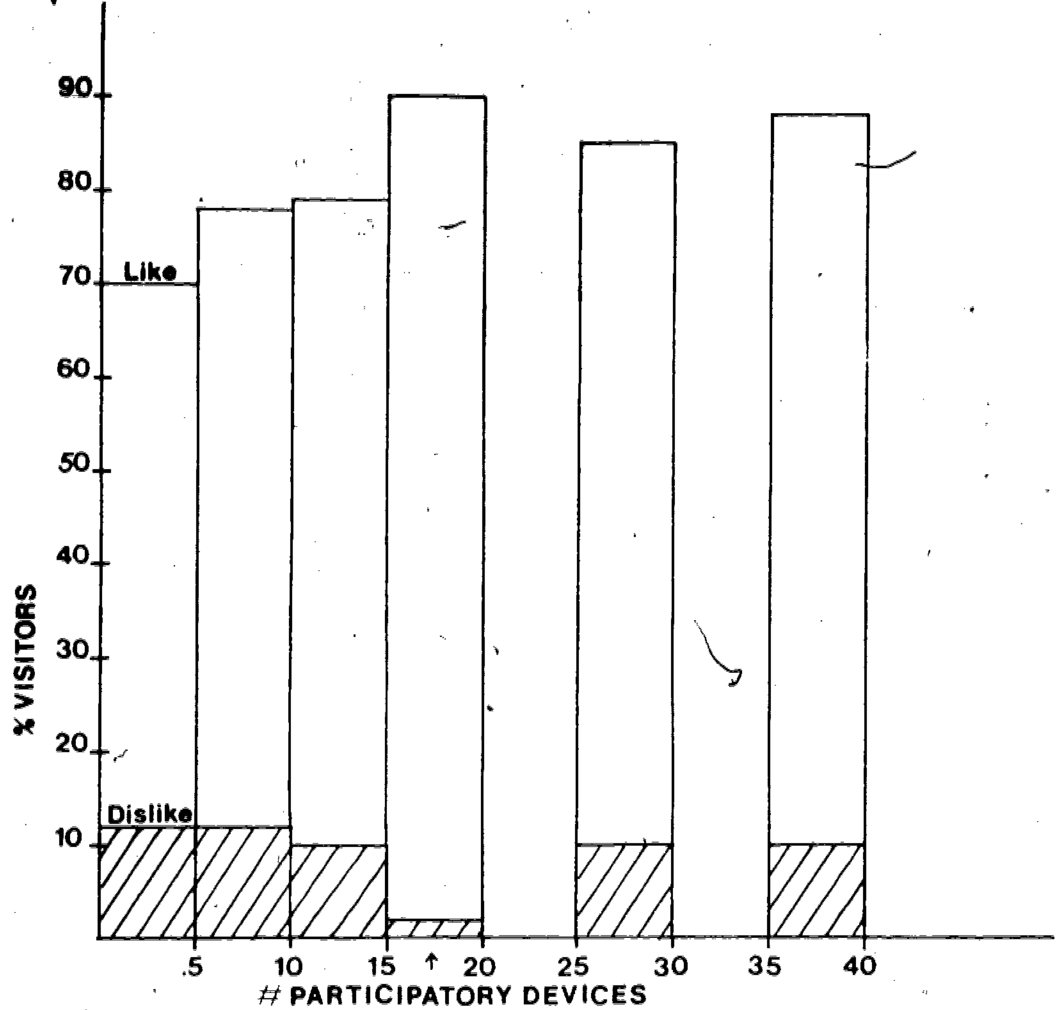
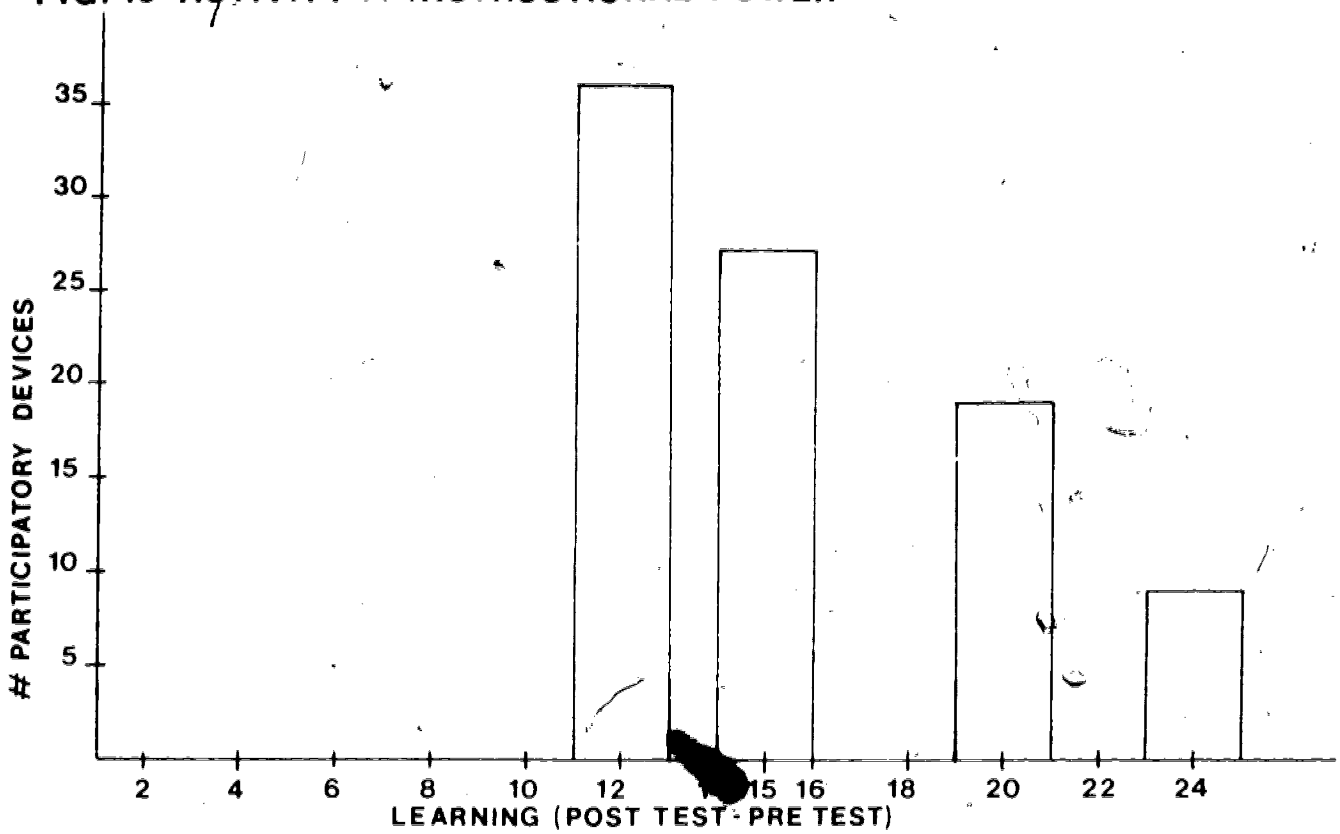


FIG. 10 ACTIVITY X INSTRUCTIONAL POWER



VIII. MUSEUM EFFECTIVENESS

We began our museum effectiveness study with a goal-rating scale. We will return now to that list in order to evaluate the museum's effectiveness in achieving these goals.

- Stimulate an interest in science: According to the visitors' interest profiles and to the scores on the science interest sub-scale of the attitude test, museum visitors are a pre-selected group having a substantial interest in science. It would seem then that the goal as stated above is inappropriate for the current population of visitors. "Stimulate" should be replaced by "maintain and increase" an interest in science. Baseline test scores indicate that interest is slightly lower at the end of a visit (pre-test: 63%, post-test 60%). On the other hand, orientation materials did increase interest levels, indicating that the lower post-visit score is not due to the waning of motivation at the end of the visit.

B. Develop an understanding of the impact of science and technology on daily life: This is the third sub-scale on the affective test. Again we see a drop from pre-test (78%) to post-test (73%). As has been previously mentioned, this is a clearly negative finding. It suggests that exposure to science and technology are not enough; the impact of items displayed on the daily life of the visitor must be emphasized in the contents and labels of the exhibit. Apparently, current exhibits are, from a visitor's point of view, somewhat remote. Their implications must be made explicit and not left to extrapolation by the visitor.

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C. Stimulate curiosity: Our original experimental design called for the measurement of curiosity in terms of the percentage of visitors who signed up to receive copies of the correct answers to the museum quiz. Since nearly 100% of the visitors taking the quiz wanted to be sent the answer sheet, we conclude that the quiz itself stimulated curiosity. There was no observable difference between pre- and post-visit groups. In light of the findings in "A" above, we can suppose that it might be wise to alter the goal from "stimulate" to "maintain and increase" curiosity, since it it is likely that our visitors are a highly curious group.

D. Entertain, amuse, and give pleasure; and

E. Develop positive feelings about the museum and a desire to return

Our "Faces Test" gives us an indication of visitors' feelings about the museum. The decrease from pre-test (78%) to post-test (66%) in the number of visitors selecting a broad smile as indicative of their feelings about the museum and the success of orientation materials such as the "Adventure Trail" (post-test 78%) tells us that more needs to be done in the area of visitor communication and orientation. Clearly, the whole context as well as the content of exhibits is important here. It seems likely that after all the changes indicated in the chapter on orientation are implemented, and the disruption of Bicentennial construction has been eliminated, visitors will have a more favorable response to the museum.

F. Teach basic science concepts

Here the museum is clearly successful. The average post-visit score (54%) shows an increase of 18 percentage points, which represents a 50% increase over the pre-visit score (36%). Particularly large increases are seen for elementary school children. For visitors who used our museum game sheets, we seen even greater increases.

It is likely that there is a limit to the amount of exhibit-based learning possible in a free-access, unprogrammed situation. Harris Shettel (1968) used a control group of paid subjects who were instructed to learn as much of the exhibit content as they could before they were tested. At best, their scores were never higher than 75%. Shettel suggests that this may represent a limit, and that some sort of response reinforcement is needed in order to exceed this threshold. The observation that an average of 50-75% of the information content of an exhibit is communicated to the casual visitor may be useful to msueum staff. It offers a realistic goal in formulating testing objectives and suggests that if the exhibit is being used for instructional purposes and the assimilation of more information is desired, a lecturer, demonstrator or adjunct teaching system (e.g., quiz sheet, game, etc.) is required.[1]

[1] For a full discussion of the use of adjunct systems in a museum context see Screven (1976).

G. Teach that science is a process, a way of looking at things

Success in achieving this goal has not been tested in this study. It is unlikely that a visit to The Franklin Institute Museum would produce significant change on such a measure since an explanation of the scientific method is nowhere explicit in the museum's exhibits and, as we have said in the case of communicating the impact of science and technology on daily life ("B" above), such information must be made explicit in order for visitors to grasp it.

H. Develop more positive attitudes toward science and technology

Here, as in the case of the highest priority goal (stimulate an interest in science) pre-visit scores are already quite high (79%); and even given a slight decrease on the post-test (which we have attributed to Bicentennial construction), we can see that the museum tends to attract visitors who have strongly positive attitudes toward science and technology. Rather than simply revising this goal to "maintain" positive attitudes, the museum staff is tending toward a changed goal of "developing an understanding of the capabilities and limitations of science and technology." This is a response to current concern with the possibly harmful long-term consequences of the indiscriminant application of science and technology.

RECOMMENDATIONS CONCERNING GOALS

Examining the overall record, recommendations with respect to goal achievement fall into four categories:

(1) Revise goals to alter expectations (in light of high pre-visit scores)

Maintain and increase interest in science

Maintain and increase curiosity

Develop an understanding of the capabilities and limitations of science and technology

(2) Develop more explicit exhibit content concerning:

Impact of science and technology on daily life

Science as a process, a way of looking at things

(3) Increase efforts to:

Entertain, amuse and give pleasure

Develop positive feelings about the museum and a desire to return

(4) Maintain current success in:

Teaching basic science concepts

IX. IMPLICATIONS OF THIS STUDY

The pilot study discussed here and the other references cited represent the first level of investigation. In addition to such single-institution studies, we must move to a second level of analysis - comparative study of data from a broad sampling of institutions - in order to test the findings of studies done in a single museum and to determine their range of applicability. This is the research model of the social sciences and natural history. It contrasts with the model of controlled laboratory experimentation usually employed in physical and biological science research. In the former case, conclusions take the form of statistical statements, with specification of execeptions, rather than tending toward definitive statements about isolated experimental systems.

One product of this pilot study is the development of a research model and a set of instruments which will allow a museum to measure the effectiveness of its exhibits and of new experiments in exhibitry and programming. We now need a comparative study of data collected in a broad range of museums in order to have a large enough sample of exhibits to distinguish general principles of exhibitry and visitor response from the effects of specific museum contexts.

A comparative study would give us a measure of the performance of visitors in a variety of museum contexts. In the case of the cognitive-affective test used in this study, our baseline data shows a slight decrease in attitude scores from pre- to post-visit. Retesting indicates that one way this fall can be avoided is through the use of specially designed orientation materials. We do not know the upper limit to which it is possible to aspire. Perhaps, as in the case of the cognitive test, a score of approximately 75% should be regarded as the goal for post-visit performance

The availability of sample data from a range of museums will allow us to observe the effects of specified museum and visitor characteristics (such as museum size, subject range and geographic location and visitor age, interest and educational background) and also to abstract those generalities which do hold true for all situations.

Such an approach is long term and could be costly in that it implies research activities in many museums, requiring the allocation of time, money and personnel. However, at the present time it appears to be the only way to get really meaningful results - results which will provide museum decision-makers with concrete guidelines and recommendations for improving existing facilities, exhibits and programs and introducing successful innovations.

APPENDIX A

EDUCATIONAL VALUE OF A MUSEUM VISIT

TEACHERS' OBSERVATIONS

EDUCATIONAL VALUE OF A MUSEUM VISIT -- TEACHERS' OBSERVATIONS

One of the most important questions which arises in connection with attempts to understand the impact of a visit to the Science Museum is "What are the lasting effects?" Does the visit produce a change which carries over t other activities? Does the museum play a significant role in a larger museum-community system involving schools, libraries, T.V., films, and other museums? Does the museum visit and the social communication of visitor's response stimulate participation in activities which will increase science learning? Does it create an increased receptivity to science learning?

It is extremely difficult to ascertain the halo effects of a museum visit. Even if visitors could be recaptured after some time, control is not possible. We couldn't say with certainty that behavior observed or reported is due to the impact of the museum visit.

In order to get some answer to these questions, we asked a sample of school teachers who brought their classes to the museum to do our observing for us. Since the teachers are able to watch the children's reactions over time, we are able to get some indication of carryover effects. A mail-back questionnaire was distributed to teachers of 200 visiting school groups as they entered the museum. Of the 59 replies received[1], 22 included a response to our question on the impact of the visit. The text of the question is as follows:

> *What evidence did you observe (if any) of a positive, negative or lack of change in your students' attitudes toward science and technology as a result of the museum*

[1] The average response rate for a mail-back questionnaire is approximately one-third.

visit? (e.g., of positive change: increase in frequency of science-related questions and class participation in science lessons; interest in science books from museum shop, library or bookstore; interest in seeing or discussing science films or watching science shows on TV; negative change: decreases in this behavior, complaints about science lessons, etc.)

Replies given in the teachers' own words are arranged by grade level. Obviously, our sample is limited and such indirect assays are somewhat biased (we are seeing the children through their teachers' eyes). Nevertheless, the following reports are certainly strong indications of an increase in science receptivity on the part of school children as a result of their museum visit.

PRE-SCHOOL

"It opened up their eyes to science and the world around them"

"They wanted to hear more stories about the constellations"

"The children remembered the things they saw. They excitedly told parents and friends the things they saw, which usually only happens when something very special happens, at this age"

KINDERGARTEN

"Trip helped reinforce unit on the Sky. Class enjoyed the visit and next day we discussed what they saw, drew pictures, wrote stories"

GRADE 1

"We had constant discussions about the exhibits we saw for days after our trip"

"Interest in science books from The Instructional Materials Center"

"Questions about what they saw. Discussions of what they saw"

GRADE 2

"They responded quite well to all in the museum and this enthusiasm was brought back to our classroom"

"It was something new to them and a different environment than a classroom"

"They expressed their liking by asking to discuss what they saw and asking questions about things that they didn't fully understand and they desired an explanation"

"Plan to visit with their own parents and families"

"Children as usual were fascinated by the Trains, Heart, Motor Technology. We discussed those exhibits in follow-up lessons and experience charts"

GRADE 3

"They want to know more about finding the constellations. We will be making star charts to use with flashlights for projection"

"A few students seemed to be more interested in science books"

GRADE 4

"The children were fascinated by the exhibits, however, I felt they were too young to really appreciate it"

"This class made an excellent response to science and this visit only aroused them all the more. Interest in museum shop and books, library and science shows"

"Several took out books from library concerning exhibits we saw"

GRADE 5

"The planetarium visit reinforced interest in astronomy. Followed up on the speakers instructions to view the sky that night. Want to have a telescope"

"During science lessons, if we mention a particular area, they bring up examples from things they saw"

SPECIAL EDUCATION

"Generated an enthusiasm and discussion of things they saw"
(Class for the Hearing Impaired)

HIGH SCHOOL

"It created added interest in their work"

"Many more questions about science in general, particularly from articles appearing in newspapers"

"As physics students and high school seniors, my students are already highly motivated and interested in science. Their enthusiasm for their astronomical observation project picked up considerably, however"

APPENDIX B

PILOT STUDY QUESTIONNAIRES

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WHY DID YOU COME TO THE FRANKLIN INSTITUTE MUSEUM?

We'd Like To Know...

Please Check Any Of The Reasons Which Apply To You:

_____ FOR FUN
_____ BECAUSE YOU LIKE MUSEUMS
_____ TO LEARN SOMETHING ABOUT SCIENCE
_____ TO LEARN HOW SCIENCE AND TECHNOLOGY AFFECT YOUR DAILY LIFE
_____ TO LEARN HOW THINGS WORK
_____ TO SEE WHAT'S IN THE FRANKLIN INSTITUTE MUSEUM
_____ TO SEE A SPECIAL EXHIBIT -- WHICH? (PLEASE FILL IN) ____________________
_____ TO SEE A PLANETARIUM SHOW
_____ TO SEE THE DEMONSTRATIONS
_____ TO BRING YOUR CHILDREN
_____ YOU ARE ON A FAMILY OUTING
_____ TO SHOW AN OUT-OF-TOWN VISITOR THE MUSEUM
_____ TO SHOW FRIENDS THE MUSEUM
_____ YOU ARE TOURING PHILADELPHIA ALONE OR WITH YOUR FAMILY
_____ YOU ARE PART OF A GROUP TOUR OR OTHER SPECIAL PROGRAM
_____ YOU ARE ON A TRIP WITH YOUR SCHOOL CLASS
_____ OTHER -- WHAT? (PLEASE FILL IN) ____________________

How Long Do You Plan To Stay? (CHECK ONE)

_____ LESS THAN 1 HOUR
_____ 1 - 2 HOURS
_____ 2 - 3 HOURS
_____ MORE THAN 3 HOURS

How Old Are You? (CHECK ONE)

_____ 7 - 14 YEARS OLD
_____ 15 - 24
_____ 25 - 34
_____ 35 - 49
_____ 50+

Is This Your First Visit To The Franklin Institute Museum? (CHECK ONE)

_____ YES
_____ NO

If This Is Not Your First Visit, When Was The Last Time You Came Here? (CHECK ONE)

_____ MORE THAN 5 YEARS AGO
_____ 1 - 5 YEARS AGO
_____ 6 MONTHS TO 1 YEAR AGO
_____ LESS THAN 6 MONTHS AGO

If You Have Been Here Before, With Whom Did You Come On Your First Visit? (CHECK ONE)

_____ FAMILY
_____ SCHOOL CLASS
_____ FRIEND
_____ OTHER -- WHO? (PLEASE FILL IN) ____________________

WE'D LIKE TO GET TO KNOW OUR VISITORS A BIT BETTER AND LEARN HOW YOU CAME TO VISIT THE FRANKLIN INSTITUTE MUSEUM. WE'D APPRECIATE YOUR TAKING A FEW MINUTES TO FILL OUT THIS QUESTIONNAIRE. PLEASE CIRCLE THE ANSWER THAT APPLIES TO YOU.

1. Where do you come from?
   A. Philadelphia B. Surrounding Suburbs C. Other (please fill in) ______

2. With whom did you come here?
   A. Alone B. With others. How Many? (fill in) ___ They are: 1. Family 2. Friends
   3. Other ______

3. Whose idea was it to come to the Museum (eg. own idea, father, mother, friend)?
   (fill in) ______ How old are you? ______ years old

4. Did you hear about the Museum recently?
   A. NO B. YES If yes, where?
   1. From friends
   2. From relatives
   3. In newspaper Which? (fill in) ______
   4. In magazine Which? (fill in) ______
   5. On TV
   6. In school
   7. Other. Where? (fill in) ______

5. Is this your first visit to The Franklin Institute?
   A. YES B. NO If no, with whom did you come on your first visit?
   1. Class trip
   2. Special group. What kind? (fill in) ______
   3. Family
   4. Friends
   5. Other

6. What are your main personal interests? (Circle as many as apply)
   A. Science B. Social Science C. Art D. Music E. Literature F. Politics G. Sports
   H. Crafts I. Other ______

7. What sciences interest you most? (Circle as many as apply)
   A. Physics, Chemistry, Engineering
   B. Biology, Ecology, Medicine
   C. Anthropology, Psychology, Sociology
   D. Math

8. What else have you done or are you planning to do in Philadelphia today?
   A. See sights B. Shop C. Restaurant D. Theater or Concert E. Sporting Event
   F. Zoo G. Movies H. Visit friends I. Other (fill in) ______

9. What do you like to do in your spare time?
   A. Go to movies B. Watch sporting events C. Go shopping D. Read E. Watch TV
   F. Go to theater or concert G. Visit friends H. Other ______

10. Are you a member of The Franklin Institute Museum? A. NO B. YES

11. Have you come to any special Museum programs in the past year?
    A. Lectures B. Films C. Classes D. Other ______

12. Did you ever work for this or any other museum?
    A. NO B. YES If yes, did you work: 1. As a volunteer
    2. Paid position. What job? ______

THANK YOU SO MUCH FOR YOUR HELP!!

HOW DID YOU FIND THINGS IN THE FRANKLIN INSTITUTE MUSEUM

WE'D LIKE TO KNOW...

HOW LONG DID YOU STAY IN THE MUSEUM TODAY? (CHECK ONE)

____ LESS THAN 1 HOUR ____ 2 - 3 HOURS
____ 1 - 2 HOURS ____ MORE THAN 3 HOURS

HOW DID YOU DECIDE WHAT TO SEE IN THE MUSEUM TODAY? (CHECK AS MANY AS APPLY)

____ WALKED UNTIL YOU FOUND AN INTERESTING EXHIBIT
____ LOOKED AT ALMOST EVERYTHING
____ KNEW WHAT YOU WANTED TO SEE BEFORE COMING IN TODAY
____ USED THE MUSEUM MAP AND DEMONSTRATION SCHEDULE
____ SAW MOSTLY THINGS YOU KNOW ABOUT AND/OR ARE ESPECIALLY INTERESTED IN
____ READ EXHIBIT ANNOUNCEMENTS ON BULLETIN BOARDS AT ENTRANCES
____ READ LIST OF EXHIBITS IN THE ELEVATORS
____ USED TEACHER'S GUIDE SENT OUT BY THE MUSEUM
____ OTHER. PLEASE EXPLAIN ____________________

HOW DID YOU LOCATE EXHIBITS AND DEMONSTRATIONS? (CHECK AS MANY AS APPLY)

____ USED THE MUSEUM MAP AND DEMONSTRATION SCHEDULE
____ ASKED GUARDS, ELEVATOR OPERATORS, OR CASHIERS
____ ASKED FLOOR ATTENDANTS
____ HAD BEEN HERE BEFORE AND KNEW WHERE THINGS ARE
____ WANDERED, LOOKED AT ALMOST EVERYTHING
____ WANDERED UNTIL YOU FOUND SOMETHING ESPECIALLY INTERESTING
____ OTHER. PLEASE EXPLAIN ____________________

HOW OFTEN DID YOU BACKTRACK OR RETRACE YOUR STEPS TO FIND EXHIBITS? (CHECK ONE)

____ OFTEN ____ SOMETIMES ____ RARELY

HOW EASILY DID YOU FIND THE EXHIBITS OR DEMONSTRATIONS YOU WANTED TO SEE? (CHECK ONE)

____ EASILY FOUND EVERYTHING YOU WANTED TO SEE
____ HAD SOME TROUBLE FINDING CERTAIN EXHIBITS AND/OR DEMONSTRATIONS
WHICH ONES? (PLEASE FILL IN) ____________________
____ NEVER FOUND CERTAIN EXHIBITS AND/OR DEMONSTRATIONS
WHICH ONES? (PLEASE FILL IN) ____________________

HOW EASILY DID YOU FIND THE FACILITIES YOU WANTED TO USE? (CHECK ONE FOR EACH FACILITY)

	NO TROUBLE	SOME DIFFICULTY	HARD TO FIND
MC DONALD'S	____	____	____
LUNCHROOM	____	____	____
REST ROOMS	____	____	____
TELEPHONES	____	____	____
ELEVATORS	____	____	____
STAIRWAYS	____	____	____

WHAT PARTS OF THE MUSEUM DID YOU SEE (CHECK ALL WHICH APPLY)

____ CONSCIOUSLY TRIED TO LIMIT WHAT YOU TRIED TO SEE TODAY
____ TRIED TO SEE EVERYTHING
____ SAW THE WHOLE MUSEUM FLOOR BY FLOOR
____ SAW ALL OF GROUND FLOOR (MC DONALD'S AND PLANETARIUM LEVEL)
____ PART OF GROUND FLOOR
____ SAW ALL OF FLOOR 1 ____ PART OF FLOOR 1
____ SAW ALL OF FLOOR 2 ____ PART OF FLOOR 2
____ SAW ALL OF FLOOR 3 ____ PART OF FLOOR 3

Did You Find That You Were Lost At Any Time?

____ YES ____ NO

If Yes, What Did You Do?

____ ASKED GUARDS
____ ASKED FLOOR ATTENDANTS
____ ASKED ELEVATOR OPERATORS
____ USED MUSEUM MAP
____ OTHER. WHAT? ____________________

How Often Do You Go To Museums?

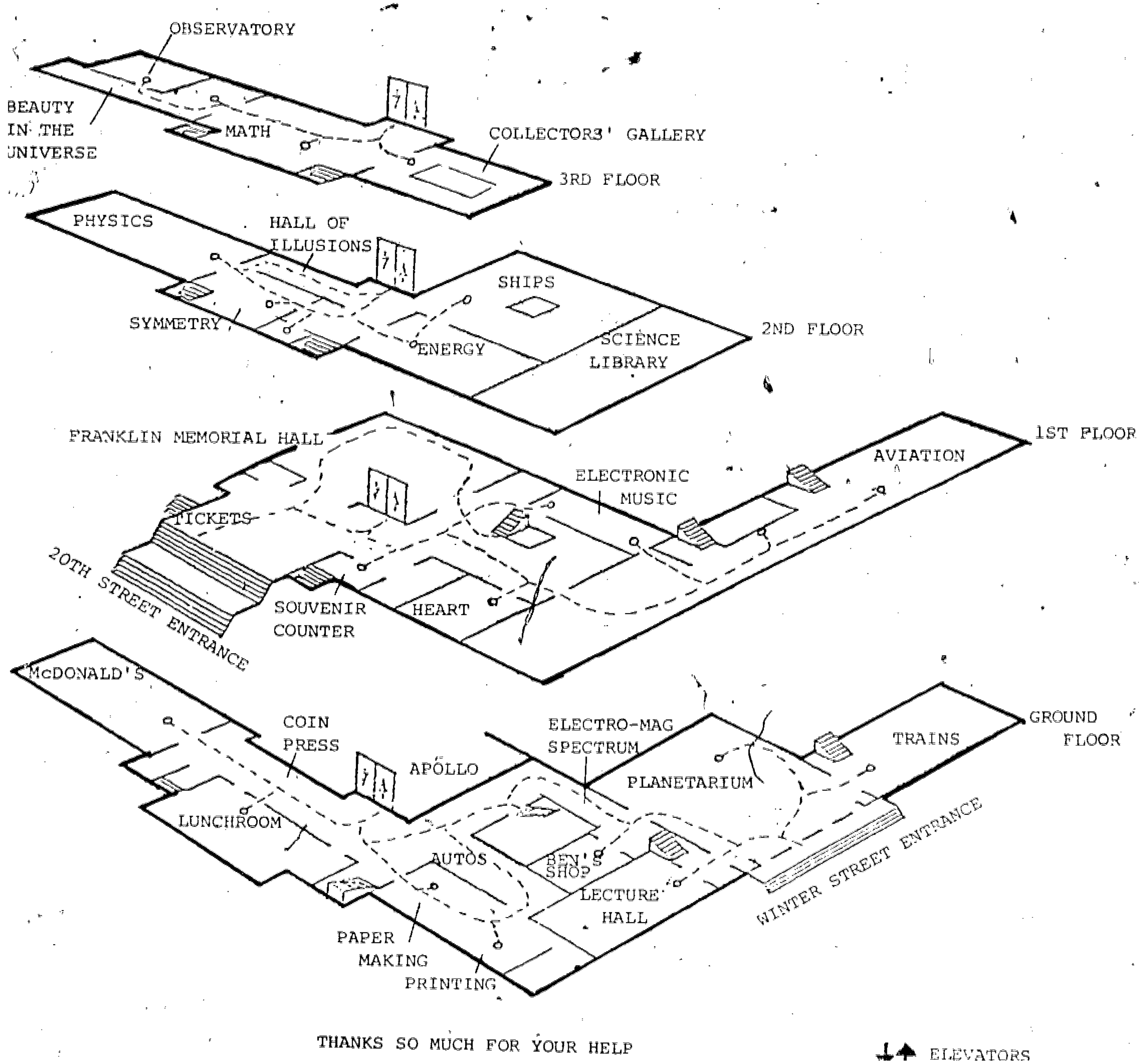
____ ONCE A YEAR OR LESS
____ 2 - 3 TIMES A YEAR
____ 3 - 5 TIMES A YEAR
____ 5 - 12 TIMES A YEAR
____ 1 - 4 TIMES A MONTH
____ ONCE A WEEK OR MORE

How Tired Are You?

____ COULD NOT TAKE ANOTHER STEP
____ WOULD LIKE TO SEE MORE, BUT AM A BIT TOO TIRED TO ENJOY CONTINUING TODAY
____ NOT VERY TIRED AND GOT TO SEE EVERYTHING
____ NOT VERY TIRED AND GOT TO SEE WHAT YOU WANTED TO SEE
____ NOT VERY TIRED, BUT LEAVING BECAUSE YOU HAVE OTHER THINGS TO DO TODAY

TRACE YOUR PATH THROUGH THE FRANKLIN INSTITUTE

We would like to see how you went through the Museum and what you stopped to look at. Start at the entrance and draw a line to show where you went. Put a star (*) on all the things you saw.



THANKS SO MUCH FOR YOUR HELP

WHAT DID YOU LIKE?

The Museum is a dynamic place -- exhibits change fairly often. Which of the exhibits did you miss and which did you like or dislike? (Please check)

	LIKE	DISLIKE	DIDN'T SEE
3rd Floor			
Observatory			
Beauty-in-the-Universe			
Math			
Collector's Gallery			
2nd Floor			
Physics			
Hall of Illusions			
Energy			
Ships			
1st Floor			
"The Man Who Chased Whirlwinds"			
"Mirrors of America"			
Heart			
Bicycles			
Aviation			
Ground Floor			
Coin Press			
Electro-Magnetic Spectrum			
Planetarium			
Trains			

TO BE FILLED OUT AFTER YOU LEAVE -- AND RETURNED BY MAIL

QUESTIONNAIRE FOR TEACHERS

We need your help in assessing the effectiveness of our museum. Please take a few minutes to complete this questionnaire. It will help make The Franklin Institute Science Museum and Planetarium a more effective teaching resource.

When you have finished the questionnaire, please place it in the enclosed stamped self-address envelope and return it to us. Thank you for your help!

NAME OF SCHOOL________________________GRADE____TEACHER____________________

Why did you bring your class to The Franklin Institute?
(Check any of the reasons which apply)
____ For fun
____ Because you like museums
____ To teach the class something about science
____ To teach the class how science and technology affect their daily lives
____ To supplement a classroom science unit. Which? (please fill in) ____________
____
____ To show the class what's in The Franklin Institute Museum
____ To see a special exhibit. Which? (please fill in) ____________
____ To see a Planetarium show
____ To see the exhibit hall demonstrations
____ To attend a museum lesson. Which one? (please fill in) ____________

How long did you stay in the museum? Check ONE:
____ Less than 1 hour
____ 1 - 2 hours
____ 2 - 3 hours
____ 3 - 4 hours
____ More than 4 hours

What else did you do with your class today?
____ Regular school program
____ Went to the zoo
____ Went to the Academy of Natural Sciences
____ Went to see some other Phila. sights. Which ones? (please fill in)
____
____ Nothing else. Only the Museum visit.

Is this the first time YOU have brought a class to The Franklin Institute Museum?
____ YES ____ NO

If this is not your first visit, when was the last time you brought a class here?
(Check one):
____ More than 5 years ago
____ 1 - 5 years ago
____ 6 months to 1 year ago
____ Less than 6 months ago

How many times in the last 5 years have you brought a class to the museum (fill in) ________

Are you interested in bringing another class to the museum?
____ YES ____ NO If not, why? ____________________

As an overall learning experience, how would you rate your class' museum visit?
____ Excellent ____ Above average ____ Average ____ Below Average ____ Poor

Do you feel the museum visit has enabled your students:

	Yes	Somewhat	Not at all
To recall basic factual information dealing with science and technology	___	___	___
To define basic science concepts and give relevant examples	___	___	___
To seek further information on things seen in the museum	___	___	___

How well did your students like the museum visit?

____ Very much ____ Somewhat ____ Not at all

How did they express this liking (or dislike) of the visit?

____

____

____

____

Did <u>you</u> like the visit?

____ Very much ____ Somewhat ____ Not at all

What evidence did you observe (if any) of a positive, negative or lack of change in your students' attitudes toward science and technology as a result of the museum visit? (<u>e.g.</u> of positive change: increase in frequency of science-related questions, and class participation in science lessons, interest in science books from museum shop, library or bookstores, interest in seeing or discussing science films or watching science shows on TV: negative change: decreases in this behavior, complaints about science lessons, etc.)

____

____

____

____

____

____

The Museum is a dynamic Institution - exhibits change fairly often - which of the exhibits did you see which you would be sad to see leave. Which would you not care about? (Please check)

Exhibit Title	LIKE	INDIFFERENT OR DISLIKE	DIDN'T SEE
Trains	___	___	___
Printing and Paper-Making	___	___	___
Weather Station	___	___	___
Lightning	___	___	___
Aviation	___	___	___
Heart	___	___	___
Physics	___	___	___
Hall of Illusions	___	___	___
Energy	___	___	___
Ships	___	___	___
Math	___	___	___
Beauty in the Universe	___	___	___
Collectors Gallery (stamps and coins)	___	___	___

APPENDIX C

EXPERIMENTAL ORIENTATION MATERIALS

FRANKLIN INSTITUTE

HIGHLIGHTS

HIGHLIGHTS

This guide will introduce you to some of the highlights of the Franklin Institute Science Museum. The tour will take about one hour. After visiting these special exhibits, you will probably want to return to explore the rest of the Museum at leisure. Your route begins at the main elevator. Take the elevator to the third floor, from there you will work your way down.

Highlight exhibits are marked by a yellow sign similar to the one which appears in the upper left corner of this page.

THIRD FLOOR - Turning to your right as you leave the elevator brings you to:

(1) MATH

Geometry is approached through puzzles; try out a few. Follow the path of a ball rolling in the celestial funnel as it obeys the mathematical laws governing the motions of satellites and planets.

(2) BEAUTY IN THE UNIVERSE

Nature is full of patterns. Order and repitition contribute to beauty in nature and provide the framework on which science is built. This exhibit gives us an opportunity to look and reflect.

(3) THE OBSERVATORY

Here you can look through the large telescope to see sunspots and as conditions permit, you may see other daytime objects including planets. Don't miss the photographs from outer space and set your watch by the atomic clock.

SECOND FLOOR - Take the elevator or stairs down one flight.

(4) ENERGY EXHIBIT

In an amusement park atmosphere, you will observe many kinds of energy exchanges as you follow the adventures of a billiard ball on its way through our "giant pinball machine". Try your strength (with some mechanical advantage) in moving a five hundred pound block of concrete.

Watch energy travel in the form of waves in the drip tank. A forty foot lable at the end of the room provides explanations.

(5) FOUCAULT PENDULUM

When you leave the Energy Exhibit, go to the main staircase and you will see a long, massive pendulum swinging far below you. The pendulum is supported by a swivel bearing up in the roof. The actual direction in which a pendulum swings remains the same. The apparent slow change in direction that takes place in the course of the day is caused by the rotation of the Earth.

FIRST FLOOR - Walk down the pendulum staircase one flight, turn to your left and proceed back along the corridor to:

(6) LIGHTNING AND RADIO

Periodic demonstrations of high voltage electricity and "man-made lightening" are given on a regular schedule. The amatuer radio station is always open with a ham operator there to talk to.

(7) AVIATION

Aircraft from the Wright Brothers to a modern helicopter and jet are here together with exhibits designed to give an understanding of the principles of flight. Notice the plans for the Wright's first successful airplane drawn on a piece of brown paper. The evolution of flight is shown in models along the corridor which leads to the Aviation Hall.

GROUND FLOOR - Go down the stairway in the Aviation area to:

(8) TRAINS

The "Rocket" was built in 1838 and the great locomotive #60,000 about ninety years later. The development of steam railroading can be followed through the exhibits in this room. At the times posted, you can actually take a ride on Locomotive #60,000 as it moves along its original tracks.

(9) BEN'S SHOP

Be sure to visit our bookstore and gift shop.

Other exhibits that you will want to see if you have more time are Paper-Making, The Heart, Weather, Air Quality Monitoring and Electronic Music. Also, check the Planetarium schedule and get in for a show there if you can. Volunteer instructors in gold coats and staff instructors in blue are stationed throughout the building to help you make the most of your visit. Feel free to strike up a conversation with any of them. They are there to be informative.

Dear Parents:

For those of you who have brought your children to the Museum, this question sheet may help make your visit more interesting and exciting.

Children can find the answers to the questions in the exhibit halls listed on the question sheet. We are giving you the answers so that you can help them to find the correct results. Of course, since the idea is to discover the answers in the Museum, we hope you won't read them until the children have visited the exhibits and searched for the answers themselves. There is some additional information, which you can read to the children, and some references for pursuing subjects of special interest.

When your children have completed the question sheet, they can return to the Information Desk in Franklin Hall Lobby and receive a Franklin Institute Certificate from the person at the desk.

Recommended for ages 5 - 10

Please tear off and leave at Information Desk:

Did you enjoy using this game sheet? YES NO

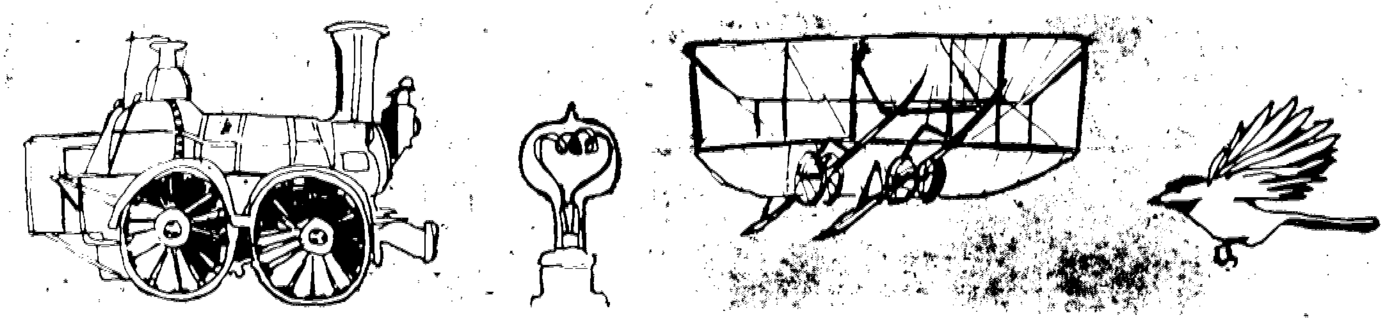
Did your child/children enjoy it? YES NO

Suggestions: ______________________________

____

____

11



Search & Discover ~ a game for young people

3rd floor

COLLECTORS' GALLERY

1. As you enter the Collectors' Gallery, there is a picture of a stamp with an airplane on it. What is wrong with the airplane? ____________

BEAUTY IN THE UNIVERSE

2. A pendulum is something that swings back and forth. In this room are 2 pendulums. One hangs on a chain and you have to start it. The other one swings by itself. Where is it? ____________

PHYSICS

3. Find an exhibit that has big pieces of wood for you to lift. How many pieces of wood are there? ____________ (Hint: count carefully)

4. In the same room, there is a big map of the world. On this map, what color are the oceans? ____________ What color is most of the land? ____________ Do you think there is more water or land in the world? ____________. Can you find Philadelphia on the map?

2nd floor

ENERGY

5. In the Energy Room there is a ladder for little people to climb. When you climb the ladder, you can look into some mirrors and see yourself. How many mirrors are there? ____________

SHIPS

6. In the Ship Room are many models of wooden boats. These boats have tall poles and lots of ropes. They are called sailing ships. What pushed a sailing ship through the water? ____________

7. On the other side of the Ship Room are large models of ocean liners and Navy ships. These ships have propellers to push them through the water. Is the propeller at the front or rear of a ship? ____________

ground floor

PLANETARIUM HALLWAY

8. On the wall near the Planetarium are some clocks showing time around the world. How many clocks are there? ____________

TRAINS

9. There are 3 steam engines in the Train Room. One is called the Rocket, another one is Number 3, and the big one is Number 60,000. All of them have wheels, headlights, and smokestacks. Only 2 of the steam engines have cars for carrying coal and water. Which one does not have a coal and water car? ____________

10. Number 60,000 steam engine has some GREAT BIG WHEELS, and some NOT SO BIG WHEELS. How many GREAT BIG WHEELS does it have? ____________

ANSWERS

1. Answer: The airplane is upside down.

   On rare occasions, the Post Office makes a mistake when printing stamps. These mistakes are so rare that when they do occur, the stamps become collectors' items. For more information on this stamp, see the Exhibit in the rear of the Collectors' Gallery.

   Reference: UNITED STATES STAMPS AND STORIES $2.00
   Available at Post Offices.

2. Answer: On the clock.

   Actually, the clock pendulum does not quite swing by itself. It is given a little push at regular intervals by the clock mechanism, just as a child on a swing must be given a little push everytime the swing returns. Otherwise, friction would cause the pendulum, or swing, to eventually stop. A pendulum makes a good timekeeper because the time it takes to swing back and forth never varies.

   Reference: *WONDER BOOK OF TIME #5045

3. Answer: 8

   Children usually believe that all wood floats. This is true for most kinds of wood, which are lighter than water. By lifting the various kinds of wood in this exhibit, you will find that ebony and lignum vitae are heavier than water, and would sink if placed in water.

   Reference: Look up SPECIFIC GRAVITY in any encyclopedia.

4. Answer: Oceans are colored blue, land is colored green.

   Being flat, this map does not give an accurate picture of the world. In reality, water covers about three-fourths of the earth's surface. This fact can be seen more readily on a globe.

5. Answer: 5

   This exhibit is the closest thing to infinity that you are likely to see. You see an infinite number of images of yourself as the mirrors continuously reflect light back and forth.

   Reference: *WONDER BOOK OF LIGHT AND COLOR #5040

6. Answer: Wind

7. Answer: Rear

For centuries, man depended on the wind for moving ships across the oceans. When the wind stopped, so did the ships. The application of steam power for moving ships, beginning in 1787 with John Fitch's Steamboat, ended man's independence on wind and sails.

Reference: *WONDER BOOK OF SHIPS #5044

8. Answer: 12

The world is divided into 24 time zones. Only 12 clocks are needed in our exhibit because each clock can be read as A.M. or P.M.

Reference: *WONDER BOOK OF TIME #5045

9. Answer: The Rocket

Heat water to 212^{O} F. and it turns to steam, expanding many times in the process and generating tremedous pressure if confined. That is the basic principle of the steam engine, and even young children can begin to understand this if they have ever heard a whistling teakettle full of boiling water.

10. Answer: 10

The big wheels, 63-½ in diameter, are the driving wheels. They are connected to each other by steel beams called side rods, which apply power equally to all the driving wheels.

Reference: *WONDER BOOK OF TRAINS AND RAILROADS #5069

*NOTE: The Wonder Books are published by Grosset and Dunlap, 1107 Broadway, New York, N.Y., 10010 69¢ each. Some of the titles are available in BEN'S SHOP.

MUSEUM ADVENTURE TRAIL

Recommended for ages 11 through adult

We invite you to explore the exhibits and to answer the following questions. ALL ANSWERS CAN BE FOUND IN THE EXHIBIT AREA.

When you have finished, you can check your answers with the list at the information desk in Franklin Hall Lobby. If you have filled in all the correct answers, you will receive a discount coupon for Ben's Shop.

THIRD FLOOR	COLLECTORS' GALLERY	1. The electric light was invented in 1879 by ___________.
	MATH	2. Lines which never meet are called __________ lines.
	BEAUTY IN THE UNIVERSE	3. SPIRALS, BRANCHING, CIRCLES and __________ are examples of beauty in the universe.
SECOND FLOOR	PHYSICS	4. The Cartesian Diver floats because it is lighter than the weight of water it ______________.
	ENERGY	5. Almost 60 percent of all air pollution comes from (check one) ____ smoke stacks, ____ cigarette smoke, ____ auto exhaust, ____ jet planes. (Hint: Look on the wall in the back of the ENERGY Exhibit).
	SHIP ROOM	6. Who owned the racing shell on display in the Ship Room? ____Ben Franklin, ____Captain Noah, ____Admiral Dewey, ____John B. Kelly.
FIRST FLOOR	FRANKLIN HALL	7. Benjamin Franklin was born in 1706 in the city of ______________________.
		8. In the year _____, Franklin was elected to a Committee to draft the Declaration of Independence.
	BICYCLES	9. The wheel of the STAR ROADSTER bicycle is _____ inches high
	AVIATION	10. The first powered flight by the Wright Brothers lasted only __________ seconds.
		11. The 4 forces that are present on an airplane in flight are: LIFT, THRUST, GRAVITY, AND ____________.
GROUND FLOOR	TRAIN ROOM	12. Locomotive No. 60,000 could carry _______ tons of coal.
	ELECTRO-MAGNETIC SPECTRUM	13. Science began with man's curiosity about the ______________________________________.
	PAPERMAKING	14. In the United States, each person uses ________ pounds of paper per year. (Average figures for 1959).
	PRINTING	15. In one square inch of a newspaper photo, there are about ___________ dots.

APPENDIX D

TEXT OF COGNITIVE/AFFECTIVE TEST

SLIDE TEST

(1) "Franklin Institute Museum Test"

(2) How do you feel about your visit to the museum today?

A	B	C	D	E
(4)	(5)	(6)	(7)	(8)

(3) This is a push-button test of our museum exhibits and your opinions.
(Push "?" for next slide)

(4) Which of these statements about The Franklin Institute do you agree with most?

- (4) A. There's something of interest for everyone.
- (5) B. It's only for people who like science.
- (6) C. You have to know a lot about science to enjoy it.
- (7) D. It's only for children.

(5) What does The Franklin Institute Museum remind you of most?

- (4) A. School
- (5) B. Circus
- (6) C. Library
- (7) D. Palace
- (8) E. Theater

FRANKLIN INSTITUTE MUSEUM QUIZ

(Correct answers are underlined)

6. WHAT IS THIS?

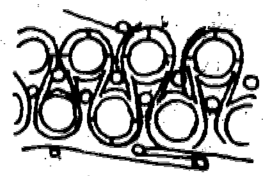
A. Thermometer

B. Pressure Gauge

C. Compass

D. Speedometer

7. WHAT DOES THIS SHOW?



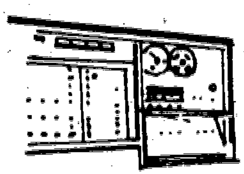
A. Forestry

B. Solar Energy

C. Paper-making

D. Printing

8. THIS IS A ...?



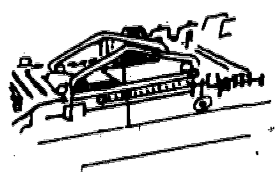
A. Generator

B. Switchboard

C. Computer

D. Synthesizer

9. WHAT DOES THIS DO?



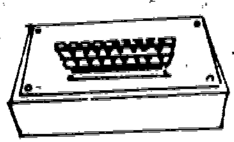
A. Hold Type

B. Mash Wood

C. Filter Pulp

D. Catch Lint

10. WHAT DOES THIS DO?



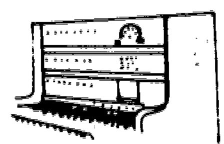
A. Play Tunes

B. Punch Cards

C. Write Letters

D. Add and subtract

11. TO CHANGE THE NOTE, YOU CHANGE THE...?



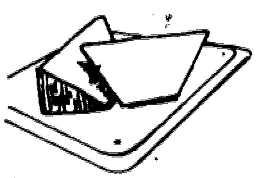
A. Speed

B. Voltage

C. Duration

D. Pressure

12. THESE MAKE WHAT SHAPE?



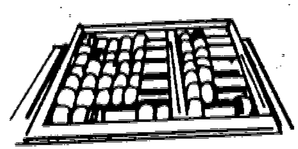
A. 

B. 

C. 

D. 

13. WHAT IS THIS FOR?



A. Measuring Spin

B. Testing pressure

C. Squaring

D. Counting

14. WHAT DOES THIS SHOW?

A. Weights

B. Volumes

C. Textures

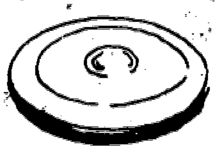
15. WHAT COMES OUT OF THE TUBE?

A. Low & High Sounds

B. Steam & Water Vap

C. Positive &

16. AS YOU SPIN, YOU ...?

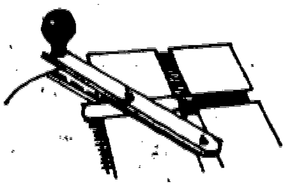


A. Rise up
B. Go faster
C. Fall outward
D. Fall inward

17. THIS IS USED IN A ...?

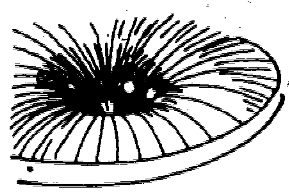
A. Fire engine
B. Light house
C. Locomotive
D. Power station

18. THE HANDLE'S PATH IS ...?



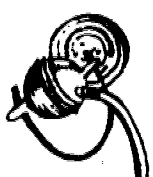
A. 
B. 
C. 
D. 

19. THE SHAPE OF THE MARBLE'S PATH IS ...?



A. 
B. 
C. 
D. 

20. WHAT HOLDS THE BALL TOGETHER?

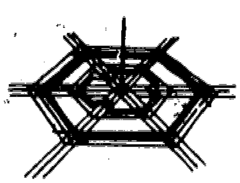


A. Gear locks
B. Electricity
C. Air pressure
D. Magnetism

21. WHAT MAKES THE PENDULUM SWING?

A. Sound waves
B. Air pressure
C. Electricity
D. Magnetic force

22. HOW MANY MIRRORS ARE NEEDED TO MAKE THIS?

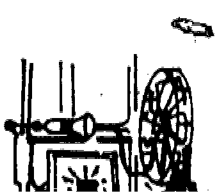


A. 6
B. 3
C. 2
D. 7

23. FROM WHERE DO THESE PLANTS GET ENERGY?

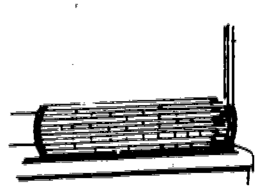
A. Sun
B. Air
C. Leaves
D. Rain

24. WHAT DOES THIS MEASURE?



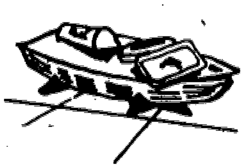
A. Voltage
B. Air speed
C. Kilowatts
D. Pressure

25. WHAT IS THIS?



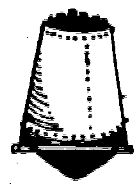
A. Thermometer
B. Pressure Gauge
C. Compass
D. Slide rule

26. FOR WHAT IS THIS USED?



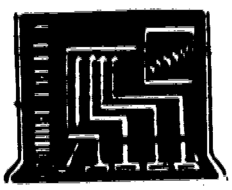
A. Undersea Exploring
B. Warfare
C. Life-Saving
D. Speed Racing

27. WHAT IS THIS?



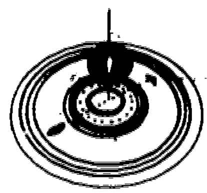
A. Sinker
B. Mine
C. Gurlie
D. Buoy

28. WHAT DOES THIS SHOW?



A. Sound Speed
B. Wave Shape
C. Harmony
D. Melody

29. WHAT DOES THIS SHOW?

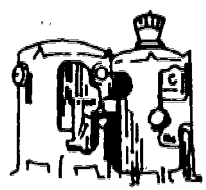


A. Speed of Light
B. Earth's Rotation
C. Perpetual Motion
D. Speed of Sound

30. WHAT PASSES THROUGH HERE?

A. Food
B. Water
C. Blood
D. Air

31. THIS IS A ...?

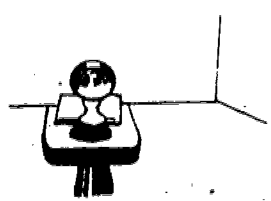


A. Undersea Lab
B. Space Station
C. Future House
D. Boiler Room

32. WHAT MAKES THIS GO?

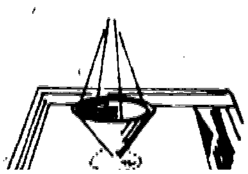
A. Electricity
B. Vacuum Pressure
C. Steam
D. Sails

33. AS YOU MOVE YOUR HAND OVER, THE SOUND...?



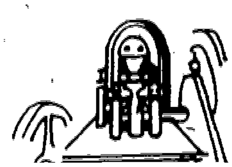
A. Gets Louder & Softer
B. Gets Higher & Lower
C. Stops
D. Goes Up

34. WHAT SHAPE DOES THIS MAKE?



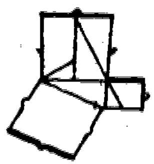
A. B. C. D.

35. WHAT DOES THIS MAKE?



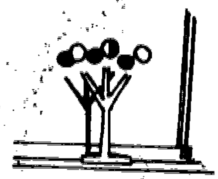
A. Paper
B. Cloth
C. Power
D. Coins

36. WHAT DOES THIS PROVE?



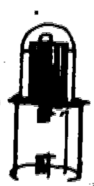
A. $a^2/b^2 = c^2$
B. $a^2+b^2 = c^2$
C. $a^2+b^2+c^2 = 1$
D. $(a)^2(b)^2 = c^2$

37. WHAT HOLDS THE BALLS UP?



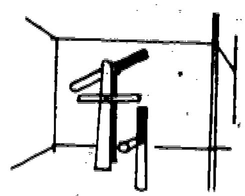
A. Steam
B. Air Pressure
C. Magnetism
D. Gravity

38. WHAT MAKES THE ROD GO UP?



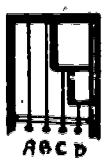
A. Steam
B. Air Pressure
C. Electricity
D. Magnetism

39. WHAT EXPLAINS THE WAY THE BAR TILTS?



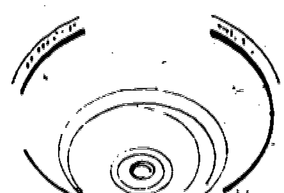
A. Unlike Poles Attra
B. Like Poles Repel
C. Unlike Poles Repel
D. Like Poles Attract

40. WHICH SWINGS FASTEST?



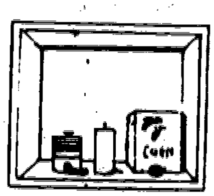
A. A
B. B
C. C
D. D

41. WHAT DOES THIS SHOW?



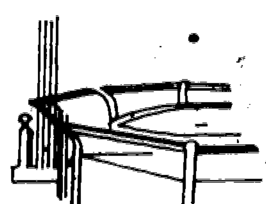
A. Water Conservation
B. Air Pressure
C. Elliptical Paths
D. Wave Motion

42. WHAT KIND OF ENERGY DO THESE HAVE?



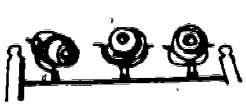
A. Kinetic
B. Stored
C. Solar
D. Electric

43. WHAT PUTS ENERGY INTO THIS SYSTEM?



A. You Do
B. Air in the Tube
C. The Marble
D. Height of Tube

44. RED LIGHT + GREEN LIGHT = ?



A. Yellow
B. Blue
C. White
D. Brown

(45) Did you see Ships?

A. Yes
B. No

(46) Did you see Papermaking?

A. Yes
B. No

(47) Did you see Electronic Music?

A. Yes
B. No

(48) Did you see Math?

A. Yes
B. No

(49) Did you see Physics?

A. Yes
B. No

(50) Did you see Energy?

A. Yes
B. No

(51) Did you see the Heart?

A. Yes
B. No

(52) And now for your opinions ... (Push "?" for next slide).

(53) How many times have you been to The Franklin Institute?

(4) A. Once
(5) B. Twice
(6) C. 3 - 5 times
(7) D. More than 5 times

(54) How old are you?

(4) A. 7 - 14 years old
(5) B. 15 - 24
(6) C. 25 - 34
(7) D. 35 - 49
(8) E. 50+

(55) How far have you gone in school?

(4) A. 3 - 6 grade
(5) B. 7 - 9 grade
(6) C. High school
(7) D. College
(8) E. Graduate school

(56) Did you major in science or do you plan to?

(4) A. Yes
(5) B. No
(6) C. Not sure

(57) Are you a scientist or do you plan to be one?

(4) A. Yes
(5) B. No
(6) C. Not sure

(58) How interested in science are you in comparison to other subjects?

(4) A. Very interested
(5) B. Somewhat interested
(6) C. Not interested

(59) Which of these statements do you agree with most?

(4) A. Science education is a "must" these days.
(5) B. It's always interesting to learn science.
(6) C. Science is not as important as other subjects.
(7) D. Science is boring.

(60) Which do you agree with?

(4) A. I would enjoy trying to solve scientific problems

(61) Which do you agree with?

(4) A. Science is so hard only trained scientists can understand it
(5) B. Most people can understand the work of science

(62) Which do you agree with?

(4) A. People need to understand science because it has such a big effect on their lives
(5) B. Science is mainly useful to scientists, not to most people

(63) "Science makes life healthier, easier and more comfortable."

(4) A. Agree
(5) B. Sort of agree
(6) C. Sort of disagree
(7) D. Disagree

(64) "Science makes our way of life change too fast."

(4) A. Agree
(5) B. Sort of agree
(6) C. Sort of disagree
(7) D. Disagree

(65) "Scientists dig into things they ought to leave alone."

(4) A. Agree
(5) B. Sort of agree
(6) C. Sort of disagree
(7) D. Disagree

(66) "Scientists work to make life better for us."

(4) A. Agree
(5) B. Sort of agree
(6) C. Sort of disagree
(7) D. Disagree

(67) "Science destroys people's ideas of right and wrong."

(4) A. Agree
(5) B. Sort of agree
(6) C. Sort of disagree
(7) D. Disagree

(68) "Science has done more good than bad for mankind."

(4) A. Agree
(5) B. Sort of agree
(6) C. Sort of disagree

(69) "Science is the cause of man's unhappiness."

(4) A. Agree
(5) B. Sort of agree
(6) C. Sort of disagree
(7) D. Disagree

(70) "A return to a simpler life would make people happier."

(4) A. Agree
(5) B. Sort of agree
(6) C. Sort of disagree
(7) D. Disagree

(71) "In the long run, our lives will be improved by science."

(4) A. Agree
(5) B. Sort of agree
(6) C. Sort of disagree
(7) D. Disagree

(72) How do you feel about science and technology?

(4) A. Afraid
(5) B. Hopeful
(6) C. Excited
(7) D. Bored
(8) E. Confused

(73) How much has science influenced your life?

(4) A. Not much
(5) B. A bit
(6) C. Pretty much
(7) D. Very much

(74) Do you think science will improve human intelligence and other traits?

(4) A. No
(5) B. Not likely
(6) C. Probably
(7) D. Yes

(75) How much does our country's future depend on scientific research?

(4) A. Not much
(5) B. A bit
(6) C. Pretty much
(7) D. Very much

APPENDIX E

INSTRUCTIONS TO VOLUNTEERS FOR ADMINISTERING A QUESTIONNAIRE

VISITOR QUESTIONNAIRE

Instructions for Volunteers

We are trying to give questionnaires to a random sample of museum visitors. This means that we can't accept replies from people who would be kind enough to volunteer to fill out our forms. We have to have a procedure for approaching people at random, as they enter the museum. If we approached only people who "look friendly" we might find out that most people who come to the museum are middle-aged adults! The purpose of the instructions which follow is to set up a way of getting a random sample. This should turn out to give us a good mix of age, sex, background, etc. If a group of people discusses the answers with the group member who has received the questionnaire, that's O.K.; but please don't collect forms from more than one person in the group. If someone really wants to fill out a form, please keep this and other such forms in a separate pile marked "unsolicited" so we can tell that these are not part of the sample.

SAMPLING PROCEDURE

Pick a fixed spot near the entrance. This is your spotting point. When you are ready to begin, ask the first person you see coming past this point to fill out a questionnaire. Approach anyone who appears to be over the age of 10 (anyone who can read and write). Try to get only one person from any family or group that comes in. When this person has finished and the questionnaire is dropped in the box provided for completed forms, ask the next person you see coming past your spotting point. Alternatively, if you find that there is room at the table for more than one person to stop and fill out a form, then approach another person passing your spotting point as soon as the first person has begun answering the questions. This may be particularly helpful on Sunday when the day is short, many visitors attend, and many questionnaires are called for.

What to say when approaching people, I leave to your discretion - any phrase with which you're comfortable which politely requests that the person fill in a questionnaire to help us understand how people like to use the museum.

DISTRIBUTION

Please clip forms from each time period together and note the date and time period at the top of the top form in each pile:

10:00 - 11:00	10 questionnaires
11:00 - 12:00	10 "
12:00 - 1:00	10 "
1:00 - 2:00	10 "
2:00 - 3:00	10 "
	50 questionnaires total

Stop giving out questionnaires when you have gotten back the total for that time period. If it turns out to take longer than the time allows, just

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