

**THE EXPLORATORIUM:
A REGIONAL SCIENCE RESOURCE CENTER**

A STUDY OF LONG-TERM REGIONAL IMPACTS

Executive Summary

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Introduction

In March of 1984 "Willy" Brown, the Speaker of the California Assembly, introduced legislation to create and expand Regional Science Resource Centers whose purpose was to "increase educational and training opportunities for the teachers and students of California." To be designated a Regional Science Resource Center an institution had to have a history of doing all the following on a regional level: "developing and operating high quality science exhibits, providing teacher training, providing educational services for elementary and secondary school pupils, and attracting a wide range of public and private support for its educational activities." The Legislation also specified that the State Superintendent of Instruction select one such center as a way to initiate and test the overall concept. Since the passage of the original legislation the Exploratorium has received multiple years of funding under the legislation and many different federal grants for its educational programs which have served a large number of K-12 teachers and students in the region. To date no other museums have been designated as Regional Science Resource Centers.

Nearly ten years later, in 1993, our evaluation group, Inverness Research Associates, was contracted by the Exploratorium to conduct a study of the ways in which the Exploratorium has indeed served as a Regional Science Resource Center. The study, which targets the nine counties that comprise the greater Bay Area, seeks to identify the degree to which and the ways in which the Exploratorium has served as a multifaceted educational resource for local schools and teachers over the last decade. In particular, the study focuses on two teacher education programs -- the School in the Exploratorium (SITE) program which serves elementary teachers, and the Teacher Institute (TI) program which serves middle and high school teachers¹.

Our study has three separate components, each of which takes a different approach to studying the effectiveness of the Exploratorium as a Regional Science Resource Center:

- a) An anonymous investigation of the Exploratorium's contributions through "blind" surveys and phone interviews with principals; school, district, and county science coordinators; and other science program leaders in the Bay Area. In conducting this study we did not identify the Exploratorium as either the sponsor or the focus of this study, but rather we asked about a wide range of resources that schools and teachers relied upon for help with their science education programs.

- b) A follow-up study of Exploratorium program participants through surveys and phone interviews.

¹It should be noted that this study was conceived as a broad investigation of the impact of the two programs. It complements a more in-depth, ongoing evaluation of the SITE program that Inverness Research Associates also conducted.

c) An analysis of the Exploratorium's multi-year records which document program offerings, participants, and funding for the SITE and TI programs since their inception ten years ago.

Overall, we surveyed over 700 past program participants and over 600 science education department chairs and school administrators located in the Bay Area. After follow-up requests we had a survey response rate of 65% for teacher participants, 76% for a subgroup of teachers identified as "highly involved" and 44% for science department chairs and school administrators.

We also carried out informal telephone interviews with approximately 35 individuals to complement the information collected on surveys. Interviews with principals, science chairs, other administrators and science program leaders explored their reform priorities, the science education resources they tended to draw upon, and their assessment of the strengths and weaknesses of the Exploratorium's educational offerings. Interviews with teachers focused on their experiences in the program and its impact on their personal and professional lives, as well as the broader influences of the teacher education programs on their schools and districts.

Major Findings

(A) Science museums were the most frequently used and most valued form of external support in a region that is very rich in science education resources.

Table 1: The rating of the extent of use and the value of the top-five rated providers of support for science education in the schools

"Please indicate how frequently you, and the teachers on whose behalf you are responding, use each of the following science education resources, and (B) your broad judgement of their value in terms of offerings, services and resources that help promote reform in science education."

PROVIDERS OF SUPPORT FOR SCIENCE EDUCATION	Elementary principals in Marin and S.F. (N = 53)		Middle and high school science chairs in the nine county region (N = 147)		Middle and high school district science coordinators (N = 63)	
	Use at least 2X/yr	Rate as very valuable	Use at least 2X/yr	Rate as very valuable	Use at least 2X/yr	Rate as very valuable
Local science museums	77%	78%	42%	59%	57%	50%
Designated mentors and lead teachers	73	71	39	37	74	85
Other experienced science teachers	62	58	59	61	68	81
District-level professional development projects/curricular resources	85	76	42	25	70	66
NSF-funded teacher enhancement projects	58	68	28	61	27	36

Our surveys and interviews yielded the following major findings:

- Science department chairs and elementary school administrators draw most heavily upon local resources -- science mentors, other experienced teachers, and the district's own professional development projects and curricular resources.
- Other than local district and school resources, local science museums are the most frequently used external resources at all educational levels. They are also among the three or four top-rated resources in terms of their overall value. (Science museums were rated higher than 13 other resources that were listed in the survey.)

(B) The Exploratorium is perceived to be one of the two most visible and well-regarded informal science education resources in the Bay Area.

Table 2: The rating of the extent of use and the value of informal science education resources in supporting science education in Bay Area schools

"Please indicate how frequently you, and the teachers on whose behalf you are responding, use each of the following informal science education resources, and (B) your broad judgement of their value in terms of offerings, services and resources that help promote reform in science education."

INFORMAL SCIENCE RESOURCE	Elementary principals in Marin and S.F.		Middle and high school science chairs in the nine county region		Middle and high school district science coordinators	
	Use at least 2X/yr	Rate as very valuable	Use at least 2X/yr	Rate as very valuable	Use at least 2X/yr	Rate as very valuable
Exploratorium	80%	91%	32%	60%	56%	62%
Lawrence Hall of Science	53	78	36	59	64	73
Nature centers and programs (e.g., Pt. Reyes Field Seminars)	50	78	17	38	59	70
California Academy of Sciences	80	90	36	51	42	56
KQED or other PBS station	47	61	68	77	46	52
Mission Science Workshop	8	60	0	20	3	60
Tech Museum of Innovation	6	40	9	47	38	56
NASA Ames	14	40	13	28	36	37

The Bay Area region is perceived to be rich in resources that support science education programs in the schools. Our "blind" study of the department chairs and school administrators discovered almost uniform knowledge of the Exploratorium's educational programs and nearly universal acclaim of their value.

Major findings emerging from the surveys include the following:

- Overall the Exploratorium along with CSIN, SSC,² the California Academy of Sciences and the Lawrence Hall of Science were the most frequently mentioned external institutional and programmatic resources by those we interviewed and surveyed.
- When asked to list the three resources that have been most useful in supporting reform in science education at the school, district or county level, about 40% of the principals who responded to the item listed the Exploratorium.
- About 20% of the responding district administrators also named the museum as one of their top three resources.
- At the elementary level, only the California Academy of Science is used as frequently and valued at the same high level.
- For district science coordinators, the Exploratorium is one of three top resources, the others being the Lawrence Hall of Science and nature center programs.

² CSIN is the California Science Implementation Network -- a science education program that is part of the California State Systemic Initiative and that serves hundreds of elementary schools across the state. SSC is the NSTA's Scope, Sequence and Coordination Program that exists in over a hundred high schools across the state.

- ▶ motivates more students to continue their interest in, and study of science (42% SITE, 48% TI).
- ▶ addresses the needs of under-represented students in science (SITE 47%, TI 45%).

Promising Future Directions

Over the last ten years the SITE and TI programs have shown that they can provide high quality professional development experiences for teachers in the broader Bay Area. The museum's programs have concentrated on relatively few individual teachers who as a result of their participation have grown enormously. In order to build upon the expertise of these teachers, to allow the museum to serve even more teachers, and to reduce the relatively high cost per teacher served, the museum is now entering a new phase of its work. In particular we see the museum beginning to take steps to leverage its work through the deployment of the teacher capacity it has helped to develop. In the last few years the museum has developed several mechanisms for allowing their advanced teachers to use the museum and its programs as an avenue for contributing to the broader reform:

- ▶ Both the TI and SITE programs have instituted Teachers in Residence programs that allow their most experienced participants to spend extended time at the museum and serve other teachers through workshops, classroom visits, curriculum development projects and a range of other services.
- ▶ The Site and TI programs has supported teacher participants in creating curricula⁴ that are based on the museum's exhibits and are designed to be used in elementary, middle and high school classrooms, as well as in the museum's own teacher education programs.
- ▶ The SITE program has instituted a program where graduates of institutes serve as Science Resource Teachers who help to provide classroom support to those teachers who graduate from the program's institutes each year.

⁴ The Exploratorium "Snackbook", produced by TI teachers, is currently being distributed nationwide by the Exploratorium.

Summary

- In other studies and reports we have discussed the notion that informal science education institutions such as science museums can serve as an important part of the national infrastructure for science education in schools. The Exploratorium is a very good example of the potential that such institutions have in terms of providing a wide range of supports to schools, teachers and students.
- It is clear from our interviews with both participants and administrators that over the past ten years the museum has successfully created a powerful reputation for itself, as well as a remarkable store of good will throughout the Bay Area. The Exploratorium is clearly recognized as one of the most used and valued science education resources in the region. In our study we found wide consensus that the Exploratorium can be counted on to mount programs that are sound, both in their science content and in their strategies for implementing inquiry teaching in the classroom.
- The Exploratorium creates a "home" for teachers, offering a safe environment for learning and growth to all those who participate in its intense programs. Embedded in a culture of inquiry, the museum staff and programs offer teachers a chance to learn about science in an in-depth fashion. Because of its permanent location and role as an ongoing resource, the museum offers teachers a chance to be part of a broader Bay Area network of like-minded colleagues.
- Over a ten-year period, the School in the Exploratorium (SITE) program for elementary teachers and Teacher Institute (TI) for middle and high school teachers have provided over 1300 teachers with intense and in-depth learning experiences in science. These teachers have had extended experiences with the museum which they value greatly. While teachers almost always rate inservices highly, the degree to which the Exploratorium plays a central role in many of these teachers' professional lives is inescapable.
- The challenge for the museum now is to continue to build its capacity to serve as a regional resource center. Much good work has been done to date by working with individual teachers in an in-depth fashion. Now the museum may be poised to build upon this work. By drawing upon the expertise of their best teacher graduates and by using the other high quality resources that exist at the Exploratorium, the museum may well be able to even more fully serve the teachers of this region.

Exploratorium Regional Science Center Study Technical Report

Table of Contents

- I. Introduction
- II. Findings from a "blind" study of science education resources in the Bay Area region
- III. A statistical portrait of the SITE and TI programs
- IV. Program findings: Experiences and opinions of program participants

Appendices

- A. Survey forms
- B. Interview protocols

I. INTRODUCTION

In 1993 Inverness Research Associates contracted with the Exploratorium to conduct a study of the ways that teachers have used the Exploratorium and the extent to which it has supported teachers in their implementation of the reform agenda in science. The study, which targets the nine counties in the greater Bay Area, seeks to identify the contributions made by and unique niche occupied by the Exploratorium in its roles as Regional Science Center. In particular, the study focuses on the School in the Exploratorium (SITE) and Teacher Institute (TI) programs. The study has three broad aspects:

- a) an "outside-in" investigation of the Exploratorium's contributions and niche through "blind" surveys and phone interviews with principals; school, district, and county science coordinators; and science program leaders in the Bay Area,
- b) an "inside-out" study of participants through surveys and phone interviews, and
- c) an analysis of the Exploratorium's records on offerings, participation, and funding for the SITE and TI programs since their inception.

Over 700 program participants and over 600 science chairs and administrators received surveys during late winter 1994. Science-themed posters were offered as an incentive to return surveys; we also mailed shorter follow-up surveys to all non-respondents. We have an overall response rate of 65% for teacher participants (and 76% for the subgroup of highly involved teachers) and 44% for science chairs/administrators.

We also carried out informal telephone interviews with approximately 50 interested individuals to complement the information collected on surveys. Interviews with teachers focused on their experiences in the program and its impact on their personal and professional lives and in their schools and districts. Interviews with principals, science chairs, other administrators and science program leaders looked at priorities and resources for furthering science education reforms in the region as well as their assessment of the Exploratorium's strengths and weaknesses.

It should be noted that this study was conceived as a broad investigation of the impact of the two programs. It complements a more in-depth, ongoing evaluation of the SITE program that Inverness Research Associates also conducted.

Major Findings

At the very broadest level, the study found that:

The Exploratorium is perceived to be one of the most visible and well-regarded science resources in the Bay Area. It has engendered a remarkable store of good will at all levels. It performs a valuable role in making science more accessible to the public, thereby creating advocates for science literacy. It has the feel of success and power about it, due to its facility, its well-regarded staff, and its ability to attract outside funding.

The School in the Exploratorium (SITE) program for elementary teachers and Teacher Institute (TI) for middle and high school teachers have served a total of about 1300 teachers who rate their experiences and its impact highly favorably. While teachers almost always rate inservices highly, the degree to which the Exploratorium plays a central role in some participating teachers' professional lives is inescapable.

The Exploratorium creates a "home" for teachers, offering a "safe" environment for learning and growth to those who all who participate in its programs and collegiality, as well as opportunities to network for more confident teachers. Teachers return to their schools not only with materials and activities, but also with deeper understandings that may well improve their ability to convey important science concepts.

There is a consensus that the Exploratorium can be counted on to mount programs that are sound, both in their science content and in their strategies for supporting change.

Although the region is resource-rich in science, the needs at the school and at the classroom level for support in reforming science are so undermet that the Exploratorium has wide latitude in defining the niches that it can best fill.

This technical report presents highlights of findings, along with illustrative graphs and tables. It updates and expands upon the preliminary findings we reported in June 1994. We first present data on our blind study of science administrators in the region; then present findings on the scope, participants and funding of the programs; and finally present findings of the study of the experiences and opinions of program participants. Data spreadsheets, interview protocol and survey instruments are appended.

For this study, Mark St. John also prepared a brief paper that discusses issues raised by these findings and their implications for the Exploratorium.

(C) The Exploratorium provides a wide range of supports for teachers, all of which contribute to improving science education in the schools.

Table 3: The forms of support for science education reform that are used and valued most as rated by school administrators, science department chairs, and district science coordinators

FORMS OF SUPPORT FOR SCIENCE EDUCATION	Elementary principals in Marin and S.F.		Middle and high school science chairs in the nine county region		Middle and high school district science coordinators	
	Use at least 2X/yr	Rate as very valuable	Use at least 2X/yr	Rate as very valuable	Use at least 2X/yr	Rate as very valuable
Summer institutes	50%	67%	39%	70%	59%	71%
School-year inservice workshops	73	76	45	46	75	74
New science curricula and materials: written	65	55	66	59	65	57
New science curricula and materials: video and computer based	53	61	64	64	62	55
Field trip opportunities for students	86	86	26	59	60	55
Scientists providing support in a classroom or inservice setting	28	63	20	48	36	46
Library service and materials	78	70	59	52	49	40

Note: Only those who have used a resource at least once were included in the ratings of value.

The Exploratorium is a multifaceted resource that serves teachers and schools in multiple ways. The museum offers professional development that varies from one-day introductory workshops to intense programs that involve teachers in institutes and extended follow-up sessions to multi-year teacher residencies. The museum helps teachers with curricula and instructional materials in ways that range from an introduction to new curriculum, to access to materials housed in the museum library, to projects that involve teachers in long-term curriculum and exhibit development efforts. The Exploratorium provides many opportunities for teachers that work in the unique environment of the museum, as well as other support services that provide extensive staff-help in the school and classroom setting. The museum programs serve both the most novice and most sophisticated teachers of science.

In our surveys and interviews it became clear that district and school administrators, along with teachers themselves, valued the following supports highly:

- ❑ The ability of the Exploratorium to provide leadership training through intense long-term programs. Summer institutes are one of the most valued forms of support for science education; about 70% of each group rated them as very valuable. Principals and district coordinators also rate school-year inservices highly.
- ❑ The tendency for teachers to develop and sustain an ongoing long-term relationship with the Exploratorium.
 - ▶ The average Teacher Institute (TI) participant has attended one summer institute, as well as more than six short workshops. About a third of post TI participants have attended more than one institute. "Highly-involved" TI teachers have, on average, attended at least two summer institutes and eight short workshops.
 - ▶ The average SITE participant has attended two summer institutes, as well as about four short workshops in the last 10 years. SITE participants expect to attend about 3 more workshops in the next couple of years. "Highly-involved" SITE teachers have about twice as much past experience with the project as compared to other SITE participants.

(D) A large majority of those teachers who participate in the Exploratorium's teacher education programs rate the museum as their most valuable resource.

A large majority of teachers who responded to our surveys rate the Exploratorium as the very best science education resource available to them.

- ❑ Nearly 85% of highly-involved teachers and about 75% of the broad participant group ranked the Exploratorium as their most useful resource. Over 97% rank it as at least better than average.
- ❑ When asked to list the three top resources in science education available to them over the last ten years, about 90% of the highly-involved teachers and about 80% of other participants ranked the Exploratorium as number one.
- ❑ A large majority of teachers we surveyed claim that the Exploratorium has made important or key contributions in their own professional development, as well as at the classroom, school, and district levels.
- ❑ The majority of teachers we surveyed and interviewed judge the Exploratorium's programs and other resources to be highly aligned with their own priorities and those expressed in science reform documents such as the State Science Framework, Project 2061 and the emerging National Science Education Standards. Between 70 and 90% of all teachers rate the

Exploratorium as more closely aligned with the national and state science reform priorities than their own schools and districts.

☐ Highly-involved participants report that the Exploratorium has been made a key or critical contribution in their fundamental beliefs about the teaching and learning of science. They report their Exploratorium experiences were central in developing their:

- ▶ commitment to a philosophy of discovery-based science (72% SITE, 59% TI).
- ▶ understanding of the underlying principles of discovery-based science (66% SITE, 55% TI).
- ▶ knowledge of the processes of scientific investigation (59% SITE, 41% TI).

☐ Highly-involved SITE and TI teachers report that the Exploratorium has had an influence on science teaching and learning at their own schools and districts.

- ▶ At least a third of these teachers are reporting that the Exploratorium has had a major impact at their schools in the overall way science is taught -- through changes in the curriculum, in increased opportunities to do paid inservices, and in administrative support.
- ▶ Over half of the SITE participants report that the SITE program has had a major impact on science teaching throughout their districts.³
- ▶ Nearly 60% of all teachers say that the Exploratorium has had a major influence on the level of district administrative support for science teaching, and another 30% say it has had some influence.

☐ A large majority of those who responded report that their experience with the Exploratorium has led to direct and strong impacts on their own students. Roughly half say that the Exploratorium has played the key or central role in helping them present science in a way that:

- ▶ leads students to be generally more enthusiastic and positive about science (66% SITE, 57% TI).
- ▶ leads to greater student competence in science (44% SITE, 48% TI).

³ It should be noted that the SITE program has concentrated their work in a few districts, providing intensive support over many years.

II. FINDINGS FROM A "BLIND" STUDY OF SCIENCE EDUCATION RESOURCES IN THE BAY AREA

This section of the study was designed to study the Exploratorium's service region by investigating the following key questions:

Which providers and types of support for reform in science education are most frequently used in the region? Which are highly valued?

What factors are critical to administrators and the teachers they represent in deciding which science education resources to use in professional development for teachers?

What are the barriers in the region to better science being taught?

What is the perceived role and value of the Exploratorium within its regional context?

Methodology

"Blind" surveys. We mailed surveys to every school and district administrator with responsibility for science education in the counties served by the SITE and TI programs. Administrators were asked to respond for themselves and "teachers they represent." There was no indication in the survey materials that the Exploratorium was the sponsor of the study.

At the elementary level, we mailed to all (public school) principals and district level science coordinators in the two counties that SITE targets, San Francisco and Marin.. At the secondary level, we attempted to reach every (public) middle and high school science chair and district level science coordinator in the nine county region from which most TI teachers come. A total of 276 administrators responded (44%).

Distribution of the survey and response rates

ADMINISTRATOR ROLE	Science administrators at the elementary school level (S.F. and Marin counties)			Science administrators at the middle and high school level (9 county Bay Area region) ¹		
	N of surveys distributed	N of surveys returned	Response rate	N of surveys distributed	N of surveys returned	Response rate ²
School science chairs	NA			359	152	42%
Principals	113	54	48%	NA		
District science coordinators	22	6	27% ³	134	64	48%
ALL ADMINISTRATORS	135	60	45%	493	216	41%

1. The nine counties in the region are Alameda, Contra Costa, Marin, Napa, San Francisco, San Mateo, Santa Clara, Solano, and Sonoma.

2. The actual return rate for administrators may be somewhat higher. An undetermined number of administrators (e.g., a principal or school science chair who is also the district science coordinator) received one copy of the survey for each role they fill. They returned just one copy

3. Results were not tabulated for this group.

As might be expected, some recipients passed along the survey to others they deemed more appropriate to complete it and some recipients fill more than one role. At the elementary level, about 70% of the surveys were completed by principals, with most of the rest presumably completed by designated teachers. At the middle and high school level, recipients checked school science chair (45%), science teacher (30%), district or county science coordinator (18%) and other 7%.

At the end of this section, graphs reporting survey findings for elementary principals (labeled P.2 - 12), middle and high school science chairs (C.2 - 12), and middle and high school district science coordinators (D.2 - 12) are presented. Complete data are presented on accompanying tables.

Interviews. We interviewed a range of administrators (principals, science chairs, and district science coordinators) whose teachers have been involved with the Exploratorium to some degree. We also talked with most of the county science coordinators in the region as well as representatives of several significant science education resources in the region. Like the surveys, these were "blind" interviews; we did not indicate our special interest in the Exploratorium until near the end of the discussion.

Priorities in science education in the Bay Area

This time the California Science Framework machine has been forceful enough to have teachers reflect on their science instruction and change it.

Interview findings

In our telephone interviews with principals; school, district, and county science coordinators and science program leaders in the Bay Area the following themes with regard to priorities in science education emerged:

This is seen as a time of change and opportunity in science. Current priorities of every administrator with whom we spoke are highly responsive to current state and national reform efforts in science and to current research in effective professional development. The California Science Framework adoption cycle is the primary driver. Science is an identified priority at the district level because of the adoption cycle, and the focus of many schools' PQRs.

Overwhelmingly, the strongest identified needs are at the elementary level -- to not only get "hands on" science taught, but science of any kind taught. Teachers who place themselves at the high, as well as the middle level of confidence and competence in teaching science need inservice. The basic cry here is "more!" Other concerns are providing access to science for all students and linking science instruction to issues and current real-world applications. At the high school level a broad array of forces (Second to None, restructuring, models of integrated or interdisciplinary instruction, entrenched tradition, the relative independence of teachers in setting their styles of science teaching) impacts perceptions of needs.

Administrators are looking for resources that make a difference in the classroom -- not cute activities, and not short term staff development. Teachers, they believe, need a mix of content knowledge, an understanding of the new direction in science education, a clear view what constructivism looks like, understandings of what changing demographics mean in terms of instruction and what it means to teach the big ideas, and opportunities to do exciting science themselves.

Some teachers and administrators simply say "hands-on" science is their highest priority. However, for others, activity-based science is not believed to be the panacea to deficits in science education that it may have seemed several years ago. Instead, they talk about the need to teach science that is centered on big ideas, as advocated by the Framework.

Administrators value genuine collaborations with outside resources like the Exploratorium. They see effective professional development in science, as in other content areas, involving an interplay between a resource like the Exploratorium and local educational agencies. A successful effort, from their point of view, would include team participation, site level planning, and follow-up like coaching. These are activities that do not always happen, but that are highly descriptive of the relationships reported by administrators who we interviewed regarding SITE.

Science Education Resources in the Region

Interview Findings

The region is perceived to be resource rich. CSIN, the Scope and Sequence Project, Lawrence Hall of Science and the Exploratorium were the most frequently mentioned outside resources by those we interviewed. Where there is categorical or grant money, other projects like MARE are influential. Math Renaissance is suggested as a model for good staff development (schools buy in, teacher is released as a regional facilitator, site leaders provide support at the site), because of the active role of the schools involved.

Administrators with whom we spoke respond to that bounty of possible allies and resources in several typical ways. At the county level, some administrators see their role as publicizing and brokering offerings -- perhaps offering a "Chinese Menu" to teachers and schools. Others describe a filtering function (e.g., "fielding fliers from 100 environmental education groups"). District level personnel perform more of a role of enabler/facilitator by funneling money and supporting school-based priorities and plans.

Survey findings

As might be anticipated, elementary principals report the heaviest usage of providers of support for science education. District science coordinators report roughly similar usage at the secondary level, and school science chairs the least (likely because they represent fewer teachers than principals and district coordinators). The chairs also tend to find resources somewhat less valuable than do the other administrators.

Much of the support for science education that administrators access at least twice a year is provided locally by mentors, other experienced teachers, and district level professional development projects and curricular resources. About 80% of elementary principals and secondary district coordinators use each of the sources at least this often.

Other than local resources, local science museums are the most frequently used resources at all levels. They are also among the top three or four resources in terms of value at each level. Over 3/4 of the elementary administrators and half of middle and high school representatives rate them as very valuable.

About 2/3 of elementary administrators and about a quarter of middle and high school administrators use NSF-funded teacher enhancement projects like TI frequently. Of those who have some familiarity and experience with these projects, about 2/3 say they are very valuable.

Ratings for selected providers are:

PROVIDERS OF SUPPORT FOR SCIENCE EDUCATION	Elementary principals in Marin and S.F.		School science chairs in nine county region ¹		Middle and high school district science coordinators	
	Use at least 2X/yr	Rate as very valuable ²	Use at least 2X/yr	Rate as very valuable	Use at least 2X/yr	Rate as very valuable
Local science museums	77%	78%	42%	59%	57%	50%
NSF-funded teacher enhancement projects (e.g., Exploratorium Teacher Institute)	58	68	28	61	27	36
Eisenhower-funded projects (e.g., Mission Science Workshop)	26	71	26	47	42	58
Designated mentors and lead teachers	73	71	39	42	74	85
Other experienced science teachers	62	58	59	61	68	81
District-level professional development projects/curricular resources	85	76	42	25	70	66
County Office of Education	38	42	30	29	51	45
State Dept. of Education	0	9	17	14	38	35
California Science Project	26	58	13	22	21	21

- Note that there is a pattern throughout of lower levels of usage reported by school science chairs, presumably because they are reporting for smaller numbers of teachers than principals or district chairs.
- Only those who have used a resource at least once were included in the ratings of value.

Forms of Support

Survey findings

The most frequently used and most highly rated resource is field trips for students at the elementary level.

Summer institutes are one of the most valued forms of support for science education; about 70% of each group rated them as very valuable: principals and district coordinators rate school year inservices as highly. The ratings for other selected forms of support are:

FORMS OF SUPPORT FOR SCIENCE EDUCATION	Elementary principals in Marin and S.F.		Middle and high school science chairs in nine county region		Middle and high school district science coordinators in nine county region	
	Use at least 2X/yr	Rate as very valuable	Use at least 2X/yr	Rate as very valuable	Use at least 2X/yr	Rate as very valuable
Summer institutes	50%	67%	39%	70%	59%	71%
School year inservice workshops	73	76	45	46	75	74
New science curricula and materials: written	65	55	66	59	65	57
New science curricula and materials: video and computer based	53	61	64	64	62	55
Field trip opportunities for students	86	86	26	59	60	55
Scientists providing support in a classroom or inservice setting	28	63	20	48	36	46
Library service and materials	78	70	59	52	49	40

Note: Only those who have used a resource at least once were included in the ratings of value.

Factors in choosing support

Survey findings

At both the school and district levels, in deciding which science education resources to use for teacher professional development, practical factors are somewhat more important overall than considerations of a resource's quality or capacity to provide particular resources. Cost, the overall quality of staff and programs, and teachers' interests/requests are among the most important factors for all three groups.

Beyond that, the three groups ranked factors somewhat differently. For school science chairs, for example, a provider's capacity to provide specific scientific content is of more interest than to principals or district science coordinators. While alignment with the Framework is a very significant factor for principals and district coordinators, only 38% of school science chairs rated it as a key factor. The factors rated as most critical for each group are:

Elementary Principals	School Science Chairs	District Science Coordinators
Cost (90%)	Cost (80%)	Overall quality of staff and programs (81%)
Teachers' interests and requests (74%)	Scheduling and timing of programs (62%)	Teachers' interests/requests (76%)
Overall quality of staff and programs (74%)	Specific scientific content covered (62%)	Cost (70%)
Alignment with the framework (72%)	Overall quality of staff and programs (60%)	Alignment with the California Science Framework (70%)
Proximity (67%)	Teachers' interests/requests (51%)	Capacity to provide support at school/district/classroom sites (65%)

Barriers to Better Science Being Taught

Interview findings

During our informal discussions with administrators, we discussed the barriers that they and teachers in their domain face that impede their desire to facilitate a high quality science program in their school, district or county.

The barrier that may be somewhat unique to the resource-rich Bay Area is a need for better coordination and communication. Without it, administrators believe that good matches between resources and needs won't necessarily be made.

Most of the other barriers administrators mention are familiar ones for science reform projects anywhere in California:

Teachers themselves. At the elementary level, many fear science and have a poor background themselves. At all levels, a) only a limited number of teachers are thought to be interested in and willing to attend professional development activities of any kind outside of school hours, and b) there seems to be an unwillingness on the part of some teachers to make the changes needed to work with new populations of students.

Distance, though this can be mitigated somewhat by summer programs that pay stipends.

The problems associated with science materials: their expense, preparation and clean up, replacing consumables.

The forces that act against an in-depth, several year concentration in a particular area, especially the state's curriculum adoption cycle.

Money, money, money.

The Place of the Exploratorium among Informal Science Education Resources in the Region

The Exploratorium is perceived to be a unique and valuable resource within the region.

Interview findings

"Speaking as someone who is not a science person, part of [the Exploratorium's] mission is to convey the marvel of science -- and that leads to other things -- an interest in discovery that has ramifications [for other learning]."

The Exploratorium is considered to be the best resource in physical science for elementary teachers. At the upper grade levels, it is seen as the best resource for physics, a strong resource for chemistry, and a developing resource for biology. More broadly, it is seen as the exemplar of inquiry-based science in the region.

The Exploratorium is perceived as being aligned with the Science Framework, and current thinking. Teachers who attend bring high quality content and activities that can be used in the classroom back to schools.

The Exploratorium's "hands-on" curriculum style has become integral to many schools and plays a key part in the way these schools teach science. Some individual teachers nurtured by the Exploratorium and closely affiliated with it have facilitated substantive changes in some districts.

Administrators report that some individual teachers who have been long-term participants in Exploratorium programs have made a real difference in not only the science offerings and instructional strategies practiced in a district, but in the overall enthusiasm for science by teachers and students.

Local and county leaders agree with teachers we interviewed on the unique strengths of the Exploratorium: above all, its power to inspire and motivate teachers who attend -- to make them personally enjoy science

Survey findings

The Exploratorium is one of the more frequently used and highly valued informal science resources by both school and district representatives.

At the elementary level, only the California Academy of Science is used as frequently and valued at the same high level.

For district science coordinators, the Exploratorium is one of three top resources, the others being the Lawrence Hall of Science and nature center programs.

School science chairs report high usage and high valuing of KQED and other PBS science programs.

INFORMAL SCIENCE RESOURCE	Elementary principals in Marin and S.F.		Middle and high school science chairs		Middle and high school district science coordinators	
	Use at least 2X/yr	Rate as very valuable	Use at least 2X/yr	Rate as very valuable	Use at least 2X/yr	Rate as very valuable
Exploratorium	80%	91%	32%	60%	56%	62%
Lawrence Hall of Science	53	78	36	59	64	73
Nature centers and programs (e.g., Pt. Reyes Field Seminars)	50	78	17	38	59	70
California Academy of Sciences	80	90	36	51	42	56
KQED or other PBS station	47	61	68	77	46	52
Mission Science Workshop	8	60	0	20	3	60
Tech Museum of Innovation	6	40	9	47	38	56
NASA Ames	14	40	13	28	36	37

When asked to list the three resources that have been most useful in supporting reform in science education at the school, district or county level, about 40% of the principals who responded to the item listed the Exploratorium. About 20% of the responding district administrators also named it.

At the elementary level, LHS and City Science were each listed by about 20% of the administrators, and the Framework by about 10%. Principals listed a number of other San Francisco district resources, as well.

About 15-20% of the school science chairs listed LHS or NSTA/CSTA. 10% named the California Academy of Science. Although they said they use and value KQED the most highly, only about 10% listed it as one of their top resources.

33% of the district science chairs listed CSIN as a top resource. They value LHS and the state framework about as much as the Exploratorium.

III. A STATISTICAL PORTRAIT OF THE SITE AND TI PROGRAMS

This section of the report provides brief program profiles describing the scope of SITE and TI in terms of program offerings, participants, and funding. This section of the study was designed to answer questions such as:

How many teachers have attended programs each year and cumulatively?

How many teacher contact hours have there been each year?

Which counties, districts, and grade levels do teachers represent?

What have been the funding sources of the programs?

What are the approximate costs of the program per teacher and participant contact hour?

This report focuses on activities and events that take place at the Exploratorium; it is important to note that another important component of SITE's work takes place at participating teachers' schools.

Program staff provided program records that are the basis for the following summary figures. A number of graphs provided for each program at the end of this section illustrate trends by year and other key points.

Teacher Institute (TI)

TI has served teachers in middle and high schools since 1983. Program materials describe TI: "The work done by the Teacher Institute is tailored to the needs of the teachers it serves. It addresses content-level issues in science and mathematics, using the Exploratorium's exhibits as a basis for investigation and discovery. Teaching methods are taught by *example* by [the] staff of scientists, all of whom hold PHDs."

Program data reported below are based on FY 1985 - 94, except for funding, which is available for 1987 to the present.

Over the life of the program:

TI has provided a total of about 6,500 hours of programs and activities (4 - 8 summer institute sections each year, 0 to 40 return sections, and 7 to 62 other programs and activities)

713 teachers have participated in TI

12% of TI teachers have attended 80 hours or less; 25 % have participated between 81 and 100 hours; 47% have participated between 101 and 200 hours; and 17% have participated for as many as 400+ hours.

If the number of hours each of each program offering is multiplied by the number who attended, a calculation can be made that TI has provided over 90,000 participant contact hours

16 teachers have taken a substantial role in institute leadership

In an average year:

About 250 teachers attend one or more TI offerings

46% of the participants are female, 54% are male

36% are middle school teachers, 58% are high school teachers, and 6% teach at other levels

63% of the teachers have participated in previous years and 37% are new to the program

They represent about 150 schools, 60 districts, and 14 counties. 42% are from

San Francisco, 18% from Alameda county, 14% from San Mateo county, 22% from the other counties in the region (Contra Costa, Marin, Napa, Santa Clara, Solano and Sonoma), and 4% from out of the area.

Each of these schools is represented by 1 - 2 teachers, each district by 3 - 4 teachers, each county by about 17 teachers

About 8 teachers serve as institute staff

TI attracts an average of \$640,000 in federal (64%), state (25%), corporate/foundation funds (11%)

Very roughly, program costs are about \$2200 per teacher, \$675 to produce/present an hour of programming, and about \$50 per participant contact hour

School in the Exploratorium (SITE)

SITE has been serving elementary teachers since 1972. Program materials describe it as "offering formal training programs and helping to design and disseminate curricula. Designed for elementary school teachers who generally have little formal training in science, SITE's workshops provide the teachers with approaches to science that are grounded in the observations of natural phenomena. Workshops are structured around such topics as Light and Color or Sound and Hearing, Vision, and Visual Perception, Electricity, and Magnetism. Short term introductory workshops provide an initial experience in activity-based science instruction. Intensive leader teacher workshops develop a cadre of highly trained and motivated teachers which can serve as a model and as a help for others."

Program data reported below are based on program records on activities and events at the Exploratorium for the ten year period FY 83-84 to FY 92-93. Program activities that take place at schools are not included.

Over the life of the program:

SITE has provided a total of over 1,500 hours of programs and activities (2 - 4 introductory workshops, 1 summer institute, and 1 - 12 other program offerings each year)

Over 650 teachers have participated in SITE

75% of these teachers have attended one 90 hour workshop, 6% have attended 91-110 hours, 14% from 111 - 250 hours, and 5% over 250 hours.

If the number of hours each of each program offering is multiplied by the number who attended, a calculation can be made that SITE has provided over 36,000 participant contact hours

Teachers from all 16 districts in San Francisco and Marin counties have attended SITE introductory workshops, and all but four districts have been represented at the leadership program

Teachers representing 120 of the 124 schools in the two counties have attended SITE (teachers from 111 schools have attended introductory workshops, and 84 schools have been represented in the leadership program)

In an average year:

About 115 teachers attend one or more SITE offerings

82% of the participants are female, 18% are male

37% are primary teachers, 59% are upper elementary teachers (grades 3-6). The grade level of 4% when they attended is unknown.

44% of the teachers have participated in previous years and 56% are new to the program

They represent about 56 schools, and 10 districts. Until 1985-86 SITE served San Francisco only; since then it also serves Marin county. Institute participants are about evenly divided between San Francisco and Marin teachers.

Each school is represented by an average of 2 teachers, each district by about 10 teachers, and each county by about almost 60 teachers

SITE attracts an average of about \$304,000 in federal (42 %), state (13%), corporate/foundation funds (45%)

Very roughly, yearly program costs are about \$2630 per teacher, \$2360 to produce/present an hour of programming, and about \$85 per participant contact hour

IV. PROGRAM FINDINGS: EXPERIENCES AND OPINIONS OF PROGRAM PARTICIPANTS

This component of the study was designed to answer the following questions:

What is the history of teachers' involvement with the Exploratorium?

In what ways have teachers used the Exploratorium's diverse resources? What has been useful to them?

What has the impact been on teachers' personal and professional beliefs and practices?

How do they see the Exploratorium influencing their schools and districts?

How aligned do they believe the Exploratorium is with the science reform agenda, their schools' and districts' and their own agenda?

Methodology

Data in this section was collected from surveys of program participants augmented by telephone interviews of a small number of teachers who have participated in the programs. TI elected to survey all reachable teachers on its mailing list (37 highly involved participants who have gone on to teach at the Exploratorium and work with teachers at their schools and 517 other teachers who have attended at any level). SITE provided mailing labels for 50 highly involved teachers who, in addition to spending a large number of hours in workshops, have also worked with the program in other capacities (e.g., co-teaching, mentoring, etc.) and to 102 other teachers who have attended at least one 90 hour summer institute.

The survey was accompanied by a cover letter from Rob Semper and an offer of Exploratorium posters for returning it. All highly involved teachers received the same survey. Two shorter forms were developed and randomly distributed for other teachers. Teachers who didn't respond were sent a shorter follow-up survey. About 3/4 of the highly involved and nearly 2/3 of other teacher participants responded.

Distribution of the survey and response rates

PARTICIPANTS	TEACHER INSTITUTE (TI)			SCHOOL IN THE EXPLORATORIUM (SITE)		
	N of surveys distributed	N of surveys returned	Response rate	N of surveys distributed	N of surveys returned	Response rate
Highly involved teachers	37	27	73%	50	39	78%
Other teacher participants	517	333	64%	103	63	61%
ALL PARTICIPANTS	554	360	65%	153	102	67%

The Survey Sample

We compared demographic data on teachers who responded to the survey to program data on all participants; we also looked for similarities and differences between highly involved and other teachers.

TI

The TI teachers who responded to the survey were quite similar to the total pool of TI teachers in terms of their school level (approx. 58% high school, 36% middle school, 6% other)

When we compared highly involved and other TI teachers, we found that highly involved teachers were more likely to be veteran, male teachers than other less involved teachers. A somewhat larger percentage of the highly involved teachers are non-white (36%) than in the less involved teacher group (24%). The two groups have similar math and science teaching loads, with 75-80% teaching science at least twice a day.

SITE

The SITE participants who responded to the survey included a higher percentage of K-2 teachers (48% for highly involved teachers, 57% for others) than the program has served overall (37%). There are minor gender differences among all participants and those who answered the survey.

Involvement with the Exploratorium

Teachers generally have an ongoing relationship with the Exploratorium.

The average TI participant who returned a survey has attended over six short workshops in addition to at least one institute and plans to attend at least three more workshops in the next several years. About a third have attended more than one institute. Highly involved teachers have, on average, attended at least two summer institutes and eight short workshops.

The average SITE participant who returned a survey has attended about four short workshops in the last 10 years, in addition to 2 summer institutes. SITE participants expect to attend about 3 more workshops in the next couple of years. Highly involved SITE teachers have about twice as much past and planned future experience with the project when compared to other SITE participants.

Overall Judgments of the Quality and Usefulness of the Exploratorium, Its Teacher Programs, and Other Exploratorium Resources

A large majority of teachers say that the Exploratorium has made important or key contributions in their own professional development, as well as at the classroom, school, and district levels. Our survey returns are likely to represent the "best case" teachers. Nevertheless, as we indicated earlier, while teachers almost always rate inservices highly, the survey responses and our interviews both suggest that the Exploratorium plays a central role in many teachers' professional lives as science teachers.

A large majority of teachers who responded to our surveys rate the Exploratorium as the very best resource available to them to support them in teaching science (nearly 85% of highly involved teachers, about 75% of the broad participant group). Over 97% rank it as at least better than average. When asked to list the three top resources in science education available to them over the last ten years, about 90% of the highly involved teachers and about 80% of other participants ranked the Exploratorium as number one.

The majority judge its workshops and other resources to be highly aligned with their own priorities and those expressed in science reform documents such as the State Science Framework, Project 2061 and the emerging national science standards. They rate the Exploratorium on this criterion of quality higher than they do their own schools and districts, with 70 - 90% judging that the Exploratorium is very aligned with science reform

priorities (with TI participants making the lower judgement).

They find Exploratorium resources useful. Highly involved teachers in both programs have made the most use of (three or more times a year) and nearly unanimously rate as very valuable:

lessons they can present based on Exploratorium experiences (81% of SITE teachers use them at least 3 times a year, as do 86% of TI teachers)

lessons presented in the classroom by Exploratorium personnel (59% SITE, 50% TI)

SITE teachers also especially value the SITE lending library of kits, slides (which 45% have used at least three times a year) and the SITE curriculum notebook (52% use it this frequently).

Contributions to Personal and Professional Development

Highly involved participants report that the Exploratorium has been made a key or critical contribution in fundamental beliefs and understandings: It has been critical for their:

commitment to a philosophy of discovery-based science (72% SITE, 59% TI)

understanding of the underlying principles of discovery-based science (66% SITE, 55% TI)

and knowledge of the processes of scientific investigation (59% SITE, 41% TI).

It may be that the higher ratings by SITE teachers reflect their initially lower level of preparation and confidence in science compared to TI teachers.

Contributions to the Classroom

Administrators cite as one of the Exploratorium's strengths the quality of the content presented and the degree to which activities can be used in a classroom. Survey responses by highly involved teachers confirm that the programs make a key contribution in motivating teachers to:

provide an inquiry-based science program (59% SITE, 55% TI)

program more time for hands-on science activities and/or exploration (63 % SITE, 64 % TI)

ask questions that don't have a right answer (53 % SITE, 62 % TI)

look at the development of curriculum in a new way (52 % SITE, 64 % TI)

Note that TI teachers are reporting slightly higher impact on their own behavior in their classrooms.

Roughly half of those who responded report that their own experience with the Exploratorium has impacted students. They say that the Exploratorium has had a key role in helping them present science in a way that:

leads students to be generally more enthusiastic and positive about it (66% SITE, 57% TI)

leads to greater student competence in science (44% SITE, 48% TI)

motivates more students to continue their interest in, and study of science (42% SITE, 48% TI)

addresses the needs of under-represented students in science (SITE 47%, TI 45%)

Contributions to Schools and Districts

Highly involved teacher share what they have learned at the Exploratorium in a variety of ways:

all or nearly all share information and Exploratorium materials with colleagues informally

about 40% of TI teachers and 20% of SITE teacher frequently organize special events or installations at their schools, give workshops or presentations in their schools, districts and to broader audiences.

Highly involved teachers report that the Exploratorium has had an influence on science teaching and learning at their own schools and districts.

At least a third of these teachers are reporting that the Exploratorium has had a major impact at their schools -- in the curriculum and the overall way science is taught, in opportunities to do paid inservices, and in administrative support.

Over half of the SITE participants report that it has had a major impact in their districts. Nearly 60% say that the Exploratorium has had a major influence on the level of administrative support for science teaching, and another 30% or so say it has had some influence.

TI teachers see the highest impact on the curriculum of their schools and districts and on the overall way that science is taught at their schools.

AREAS IN WHICH THE EXPLORATORIUM HAS HAD AN INFLUENCE ON SCHOOL CHANGE	Highly involved SITE teachers who say that the Exploratorium has had an influence at the school level		Highly involved TI teachers who say that the Exploratorium has had an influence at the school level	
	Major Influence	Some Influence	Major influence	Some influence
Science curriculum	35%	52%	45%	50%
Overall way that science is taught	29	58	33	29
Level of administrative support	45	52	36	59
Opportunities for Exploratorium participants to provide inservice for colleagues	32	26	40	35

AREAS IN WHICH THE EXPLORATORIUM HAS HAD AN INFLUENCE ON DISTRICT CHANGE	Highly involved SITE teachers who say that the Exploratorium has had an influence at the district level		Highly involved TI teachers who say that the Exploratorium has had an influence at the district level	
	Major influence	Some influence	Major influence	Some influence
Science curriculum	52%	39%	43%	38
Overall way that science is taught	59	25	33	19
Level of administrative support	59	31	38	33
Opportunities for Exploratorium participants to provide inservice for colleagues	32	39	35	25