Toward a Bay Area Science Learning Collaboratory

Leveraging San Francisco Bay Area Science-Technology Museums and Other Informal Science Education Programs as a Key Educational Resource for Student Learning and Teacher Professional Development

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Prepared for
The William and Flora Hewlett Foundation
Menlo Park, CA

By

DesignWorlds for Learning, Inc.
http://www.designworlds.com

In Collaboration with

ROCKMAN *et cetera*
San Francisco, CA
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March 15, 2002

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Acknowledgements

The research leading to this report was a result of some initial exploratory work done at the request of Dr. Ida Oberman, former Education Program Associate with the William and Flora Hewlett Foundation (and now at Partners in School Innovation) and Dr. Marshall M. Smith, Education Program Director of the Hewlett Foundation in July-August 2001. The research summarized in this report was supported by Hewlett Foundation grant #2001-7331 to ROCKMAN *et cetera,* in collaboration with DesignWorlds for Learning, Inc.

We would like to express our deep appreciation to Ida Oberman and to Mike Smith and Sally Tracy of the Hewlett Foundation for their interest and generous support of this work in support of education and lifelong learning.

We express thanks to Frona Kahn for her background research; Akiva Lewis and Larry Harris for transcribing several taped interviews; Stephanie George from ROCKMAN *ET AL*, and Jack Gottsman for their generous support, editorial comments and assistance.

We also wish to thank the following for their interest, interviews, comments, and suggested contacts: Dr. Craig Baker (The Tech Museum of San Jose), Dr. Rick Berg and Jenni Martin (Children's Discovery Museum of San Jose), Bronwyn Bevan (Exploratorium, Acting Director of the Center for Informal Learning and Schools), Wendy Coones (Exhibit Specialist, Chabot Space & Science Center); the Honorable Susan Hammer (former Mayor of San Jose, Vice Chair, California State Board of Education and CEO, Synopsys Outreach Foundation), Krishen Laetsch (Oakland Education Cabinet, Mills College, and former Co-Director of the LITES Project), Dr. Watson M. Laetsch (former Executive Director of the Lawrence Hall of Science, U.C. Berkeley), Gary Robinson (Executive Director, Synopsys Outreach Foundation), Dr. Sherman Rosenfeld (Weizmann Institute of Science, Israel), and Dr. Art Sussman (WestEd , Co-Director of the Southwest Regional Eisenhower Consortium).

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March 12, 2002

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Executive Summary

Toward a Bay Area Science Learning Collaboratory: Leveraging Bay Area Science-Technology Museums and Other Informal Programs in Science, Mathematics, Engineering and Technology as a Major Learning Resource for Regional K-12 Schools

I. Background and Activities Performed

Over the past 35 years, there has been a growing recognition of the important role museums and other informal learning institutions play in helping students learn, as well as in supporting the continuing professional development of teachers. The Hewlett Foundation recognizes the importance of such collaboration, and funded this study to explore possible collaborations among different Bay Area museums and informal learning programs. The goal of this study is to provide insight into how the Hewlett Foundation might leverage the extensive collections of exhibits, online and other learning resources, curriculum and professional development programs to directly meet the needs of K-12 schools in the Bay Area. From October 2001 to February 2002, the lead researcher (Dr. Kahn) engaged in the following research activities relevant to this grant:

- **Extensive research on the national landscape on science-technology museums and informal learning institutions**, including identifying and making contact with key individuals, institutions, and organizations involved in this effort in the San Francisco Bay Area.

- **Collection of data and previous studies** from organizations that capture the depth and range of activities involved with science-technology museums informal science learning, as well as collaborations and partnerships among museums and with other educational institutions, such as K-12 schools. This review included a major 1996 national survey of museums and other informal science learning institutions (Inverness Research Associates, in collaboration with the Association of Science-Technology Centers), which summarized key data on use of science museums by teachers and students. However, regional data on Bay Area institutions alone was not available from this study.

- **Search for and research into current activities and curriculum development partnerships** between science-technology museums, informal science education projects, higher education, research and business, and the schools (nationally, as well as locally), as well and other informal science education programs for students and teachers.

- **Conversations, phone or in-person interviews,** and/or site visits to a small number of key Bay Area leaders and practitioners in museums and other informal science learning institutions about one or two specific efforts in their own past or current institutions. The organizations interviewed included: Lawrence Hall of Science, Leadership Institute in Teaching Elementary Science (LITES), Exploratorium, Children's Discovery Museum of San Jose, Tech Museum of San Jose, Synopsis Outreach Foundation, WestEd Eisenhower Regional Consortium for Mathematics and Science, Bay Area Science Alliance (BASA), and the CHILDMUS listserv.

- **Attendance at two meetings of the new emerging, WestEd-sponsored Bay Area Science Alliance (BASA**), a gathering of science educators and informal/formal science education programs and institutions (November 2001, and January 2002). A list of the over 80 Bay Area institutions who are participants or members of this new alliance is included in Appendix A of this report.

- **Summary of emerging technologies** used both inside museums, as well as for remote access to the museums and public education outreach from the museums, with a focus on opportunities for greater collaboration among museums, higher education, business & research, and the schools.

II. Analysis

The focus on science-technology museums and related informal science education institutions and programs in the Bay Area resulted in the following findings:

- **Science institutions and K-12 schools collaborate.** The most common forms of collaboration or partnerships between informal science institutions and the local K-12 schools are: school visit programs, teacher professional development workshops, educational outreach programs in the schools, student docent/internship programs (mostly high school students) and after-school or summer classes, events, and summer camps for students.

- **Multiple organizations on local, state, and national levels collaborate.** Curriculum development, teacher preparation, and professional development projects, such as those funded by the National Science Foundation and the U.S. Department of Education, are the main kinds of collaborations involving multiple local (and other) partnerships and collaborations. Special events, such as live webcasts (e.g., Live@ Exploratorium) or the Jason Project broadcasts, also frequently involve two or more partners, as well as the schools.

- **Major national or international collaborations are more frequent and visible than sustained local collaborations.** Major national or international collaborations, such as the recent Center for Informal Learning and Schools

(CILS) and web-based collaborations such as the IBM-funded http://www.TryScience.org or the Eisenhower Regional Consortia's http://www.ScienceAdventures.org, are more frequent—and often much more visible— than sustained local collaborations between multiple museum and informal science learning providers. Also, there are many smaller informal science learning institutions and programs that need much more visibility to Bay Area teachers in terms of their resources and programs.

- **Science curriculum-related resources from informal science institutions are underutilized in classrooms.** Despite the fact that thousands of Bay Area teachers have visited various museums and informal science programs, either with their students or as participants in teacher professional development workshops, it is clear that there is little use of the exhibits and other available science curriculum-related resources from these institutions in daily instruction in the classroom.

- **School visit programs to museums and other institutions are infrequent.** School visits to museums and other institutions take place primarily with elementary schools, and occasionally, with middle schools. Such visits with students to any given individual institution may occur once a year, and these visits are even more rare in under-served communities.

- **Few coordinated efforts have been made to connect Bay Area teachers and existing classroom curriculum with informal science learning resources and programs.** With one or two exceptions (e.g. the LITES science education institute for elementary teachers in Oakland), few coordinated efforts have been made to introduce Bay Area teachers to the wealth and diversity of the informal science learning resources available onsite at each of the Bay Area museums and other informal science learning programs and next to no effort has been made to systematically align these resources with the science curriculum these teachers teach.

- **The amount of teacher use of web-based science curricula, materials, and interactive learning opportunities provided by various Bay Area museums and other informal science education institutions is unknown.** The Web has created a much more visible presence for the kinds of curricula and supplementary science learning resources, as well as professional development opportunities at most of the Bay Area museums and informal learning programs. However, we do not currently know how much actual use teachers (or their students) make of these resources on a regular basis.

- **Museums and informal learning programs appear interested in the development of sustainable collaborations.** The key to success of such collaborations is to provide ways in which each institution's unique core competencies and assets can be leveraged and can complement those of other institutions to provide a synergy of resources and experience to teachers, students,

and parents. The use of the web as a resource, coupled with a coordinated programmatic content development effort—one which easily provides alignment of activities and resources with science education standards—is seen as a particularly effective way to accomplish this kind of collaboration.

III. Recommendations for Action by the Hewlett Foundation

1. Create the infrastructure to support collaboration and partnerships between informal science institutions and the local K-12 schools:

- **Support collaborations among Bay Area informal science institutions and local K-12 schools.** Create a study based on the methodology used in the 1996 ASTC national survey, but aligned to the resources and educational opportunities in the Bay Area. Include in this survey the current use of various technologies including the web, by these institutions to support both improved user exhibit experiential learning, better remote access, enhanced educational outreach.

- **Support a pilot project to select, inventory, and catalog existing web-based interactive learning opportunities from key museums and informal science education programs.** Programmatically link one or more of the "big ideas" from the National Science Education Standards so that each "learning object" would be aligned with both California state science curriculum standards and frameworks, and combined with learning guides to facilitate access and use. An increased number of teachers would have access to the experiences and resources available from different museums and informal learning programs help students learn "the big ideas" in science, as recommended by the National Research Council and AAAS, as well as by the California Science Standards. (Preliminary inquiry letter submitted to Hewlett Foundation, January 17, 2002)

- **Support a pilot program to demonstrate the effective integration of multiple technologies to engage museum- and center-goers and extend the experiences of students and teachers.** These technologies could range from low-cost, handheld wireless devices (such as web-accessible PDAs or smart toys) to wireless laptops, small digital video cameras and webcasting facilities, to high-bandwidth, highly-immersive advanced-learning environments that can showcase exemplary use of distance learning, telepresence, simulation and visualization as means for cross-institutional collaboration in science learning. Bay Area museums and informal/formal science education providers who are creating interactive learning experiences for various museums and informal learning intuitions would co-design the pilot program. Teachers and students may continue or extend an experience after having visited one of these institutions, either on the Web, through remote access to video or distance learning presentations, or through handheld computer explorations, both in schools and at home.

- **Provide transportation and "visitation" grants to schools and school districts**. Encourage and enable teachers and students, especially those attending underserved schools, to visit Bay Area museums and informal learning institutions much more frequently during each school year. This activity would help to accelerate the adoption of the two pilot programs identified above.

2. Develop and support a learning community

- **Provide fellowships for teacher collaboration with museums**. Enable teachers to work with museum staff to create educational components of current and planned exhibits and link existing school curriculum to the work of the institutions. Fellowship activities could take place during summer vacation or a few days per week during the school year.

- **Convene a meeting of key science museum educators and other science center directors in the Bay Area**. Include the key foundation program officers who are actively supporting science educational reform efforts in Bay Area schools and museums. Use the concept of creating a networked Bay Area Science Mathematics, Engineering and Technology Lifelong Learning Collaboratory as the focus for such a conference, and encourage the participation of the smaller organizations and centers in the region. Extend this dialog and continuing the building of this community through Collaboratory meetings at existing conferences and activities of groups such as BASA and others (e.g., the California Science Teachers Association and National Science Teachers Association conferences, The Exploratorium/CILS' Fall Institute, etc.)

- **Design a new kind of charter school**. Build around the exhibits, lesson plans, professional development activities, and other learning resources of Bay Area BASA members. Work collaboratively with a group of representatives of the science-museum and informal science learning community, including the staffs of CILS (Exploratorium), the Noyce Center for Learning, Bay Area participants in the CORAL and Youth Museum grant programs of the James Irvine Foundation, and groups such as BASRC and the Coalition of Essential Schools to develop an initial planning process to harness and leverage the extensive science education resources of these institutions as central to the teachers' practices in this new kind of school.

Toward a Bay Area Science Learning Collaboratory

I. Introduction and Overview

This report explores how San Francisco Bay Area science and technology museums and other informal science education programs can collaborate with schools and with one another, including use of the web and related technologies, to help address a critical need to improve science, math and technology learning for all students in Bay Area K-12 schools. The museum exhibits, learning experiences, web resources, curricula internships/docent programs, and professional development programs for teachers at these local museums, aquariums, and zoos, in collaboration with higher education, educational research, and business and industry partners, represent a cumulative investment of hundreds of millions of dollars over the past 35 years by federal grants programs (such as those of the National Science Foundation, NASA, and the U.S. Department of Education) as well as grants and contributions of private foundations, corporations, and individual donors, The combined resources of these institutions represent one of the largest and richest aggregate curriculum resource for teachers and parents for engaging students in active science and mathematics learning. The explosive growth of the World Wide Web and related distance and digital learning technologies (both for individual and classroom learning experiences, as well as distributed collaborations among different schools and community professionals) further extends the potential of this rich resource for remote access and learning over both time and geographical distance.

The greater San Francisco Bay Area has been, and continues to be, one of the richest resources in the nation of museums, universities and colleges, research institutions, and businesses in which science and the development of new technologies are at the heart of these enterprises. These local museums and other informal science education programs form an important part—and in fact, a key leadership role—as an often "invisible" part of a national education and lifelong learning infrastructure (Inverness Associates, 1996). Given the relatively poor national performance of American students on science achievement on the Third International Mathematics and Science Study (TIMSS, 1995) and the fact that California tied for last place in student science achievement in the most recent National Assessment of Educational Progress (NAEP), our community must explore all avenues possible to assist students in becoming scientifically literate, both as informed citizens of our democracy, as well as future participants in knowledge-based enterprises which require continuous ability to learn, create and share new knowledge, and to apply curiosity, inquiry, research to support national and global innovation.

The purpose of this study was to explore what kinds of collaborations have taken place among various Bay Area informal learning institutions, in partnership with local K-12 schools, with a special focus on strong relationships with under-served school communities. Bay Area science-technology museums and educational research and development partnerships (and other informal/out-of-school education and learning programs) are well known, both nationally and internationally, as leaders in promoting

educational reform in science, mathematics, engineering, and technology education, as well as in using the arts as a creative means of promoting interdisciplinary communication and sharing of knowledge and experience. Key questions that this study addressed included:

- How often and how deeply do Bay Area museums and informal learning institutions collaborate with one another (locally), as well as with major local urban and under-served K-12 schools, to improve student achievement and provide better opportunities for teacher professional development?
- What forms do these collaborations take?
- What are the incentives and inhibitors for more local collaborations among the informal science education institutions, both with one another and with local schools and school districts?
- What role might the web and new related technologies take in facilitating or supporting more or deeper Bay Area collaborations to leverage student science learning and teacher professional development on a local and regional basis?

This study focused specifically on content in science and technology, together with mathematics and interdisciplinary design—based learning in engineering and technology. We also wished to focus attention on some emerging technology-related efforts by and among these institutions to improve access and continued engagement of students and professional development of teachers, through using the Web and digital communications technologies.

II. Activities of this Study

In July-August, 2001, Dr. Ida Oberman (then Education Program Associate of the Hewlett Foundation), on behalf of Dr. Mike Smith and the Education Program of the Hewlett Foundation, requested the author (Kahn) to do a short summary of existing museums and informal learning institutions in the greater Bay Area. The purpose of this exploration was to begin to map the landscape of kinds of out-of-school and after-school learning resources which existed already and which could potentially be leveraged to improve student learning and achievement, as well as continued teacher professional development, in urban and under-served K-12 schools. The author gathered a list of over 100 museums and informal learning institutions in the greater Bay Area, from Sacramento to Monterey, and this list can be found in Appendix A. (Note: An related annotated web site, created by the Eisenhower Regional Consortia for Mathematics and Science Education, of major informal science learning institutions, including science-technology centers, aquariums, zoos, nature preserves, and planetariums and observatories all over the U.S. can be found at http://www.scienceadventures.org.)

A proposed follow-on study to further explore possible collaborations and leveraging of these informal learning resources, especially using the Web and new digital media, was supported by the Hewlett Foundation in October, 2001, under a special grant to the author (Kahn) in collaboration with ROCKMAN *et cetera.* The focus of this work, described in this report, was specifically on informal science and technology learning institutions and programs. From October, 2001, - March 2002, this study included:

1. A very general outline of the national landscape on science-technology museums and informal learning, including key individuals, institutions, and organizations involved in this effort.
2. Finding data and previous studies from organizations that summarize the depth and level of activities involved with informal science learning, as well as collaborations and partnerships between museums and the K-12 schools.
3. Web research of some of the kinds of activities and curriculum development partnerships now going on between Bay Area museum, higher education, research and business, and the schools (nationally, as well as locally), as well and other informal science education programs for students and teachers
4. Interviews with and/or site visits to a small number of key Bay Area leaders and practitioners in museums and other informal science learning institutions about one or two specific efforts in their own past or current institutions.
5. Attending two initial meetings of the new emerging, WestEd-sponsored Bay Area Science Alliance (BASA) of science educators and informal/formal science education programs and institutions
6. Participating in the ongoing planning of one potential project for use by multiple museums and school communities, created by internationally-known television series host and author, James Burke ("Connections") around an emerging web-based "Knowledge Web" of connections of over 2,200 people

throughout history, together with their ideas, and inventions linking science and technology (Burke, et al. 2002).

7. Summarizing some emerging technologies that are being used by museums, with a focus on opportunities for more collaboration among different museums, higher education, business & research, and the schools.

III. Overview of the National Landscape of Museums as Sources of Informal (Science) Education

Over the past decade, there has been a growing national awareness of the value of museums as a major educational resource for American schools. In 1992, the American Association of Museum's Taskforce on Museum Education issued a landmark report that affirmed:

> *Museums perform their most fruitful public service by providing an educational experience in the broadest sense: by fostering the ability to live productively in a pluralistic society and to contribute to the resolution of challenges we face as global citizens.* (Hein & Alexander, 1998)

Thirty years ago only about one out of every ten Americans regularly visited museums; in the mid 1980's, this percentage had increased to one in four. Today, it is estimated that museums draw more than 500 million annual visits (Hein & Alexander, *Ibid*.) and between 40-60% of all Americans visit museums at least once a year (Falk & Dierking, 2000, 2; Lusaka & Strand, 1998; Falk, 1998). These figures are growing at even a faster rate if we include "virtual visits, " now that the World Wide Web has become a major remote access point for virtual visits, online learning and exploration, and as "portals" for curricular resources for teachers, parents and students (Kahn, et al., DesignWorlds for Learning, 2000, Kahn, 1999).

Research on the nature of informal learning in institutions such as museums, zoos, and other environments has been going on for the past 25 years or so, led initially by a number of doctoral students from the U. C. Berkeley SESAME graduate program in science and mathematics education (e.g., Rosenfeld, 1979; Diamond, 1986). This program had strong relationships with the activities and curriculum development activities of the Lawrence Hall of Science (LHS) during the 1970's and 1980's, when SESAME faculty member, Dr. Watson M. Laetsch, was the Executive Director of LHS.

John Falk (also a former SESAME graduate) and Lynn Dierking, two leading museum educators and educational researchers specializing in learning in museums and other informal settings, led a number of conference participants in identifying "what people learn as a consequence of museum experiences" (Falk & Dierking, 1995, cited in Hein & Alexander, *Ibid*.):

- Museums make content and ideas accessible, facilitating intellectual "connections" and bringing together disparate facts, ideas, and feelings.
- Museums affect values and attitudes, for example, facilitating comfort with cultural differences or developing environmental ethics.
- Museums promote cultural, community and familial identity.
- Museums foster visitor interest and curiosity, inspiring self-confidence and motivation to pursue future learning and life choices.
- Museums affect ***how*** visitors think and approach their worlds, in contrast to *what* they think.

The nature of the learning experience in museums has also been summarized by The Institute of Museum and Library Services (1996) as:

> *…a change in an individual's knowledge, skills, attitudes, beliefs, feelings, and concepts. Learning may be more or less active and more or less self-directed, or passive and even accidental, and occurs at all stages in life.*

Such a definition of learning harks back to psychological research on the nature of incidental learning, fits well within the context of constructivist views of the nature of learning and learning as "knowing and sense-making through doing." (Dewey, 1938; Roschelle, 1995; Falk & Dierking, 2000).

Furthermore, the museum learning experience is, more often than not, a very social experience. As Hein & Alexander (op cit., 22-23) summarized, "Families follow purposeful but personal agendas in which social interaction is a key element." This description is one that supports a view of learning as being fundamentally situated in social and environmental contexts. In this context, "family groups" may also be groups of 3-4 peers or friends or even inter-generational groups, not necessarily members of a single family,

School visits, one of the most widespread forms of museum visits, often have a lasting impact on children, offering "a distinctive opportunity to learn from objects." (Hein & Alexander, 1998). Furthermore, students who have done preparation, reading, or work prior to their visit learn more from the experience, supporting a view that prior knowledge is necessary for optimal learning (Hein & Alexander, Ibid.; Roschelle, 1995).

IV. Science Museums & Informal Science Learning Centers: An "Invisible Infrastructure" for Science Education & Informal Learning

Science museums and other informal science learning centers provide numerous forms of education and learning opportunities for students, teachers, family groups and the general public. For schools, these include the following:

On Site:

- School visits & guided tour programs (both general museum visits and special traveling exhibits)
- Special events (e.g., a live webcasts, special exhibits, lectures, competitions, or workshops)
- After-school, evening and summer classes for students and families
- Student docent and internship programs
- Teacher pre-service and in-service professional development programs
- Curriculum and other educational resources

Remote Access

- Web access to museum curriculum/lesson plans, interactive learning and information resources
- Facilitation of online discussions and science learning community activities of students, teachers, scientists, artists and professional scientists
- Classroom or home access to live videoconferencing and "telepresence" to remote scientific expeditions (e.g., NASA's "Live from the Hubble Telescope," the JASON Project, etc.)

Educational Outreach

- School visit programs, with museum educators providing hands-on exhibits or mini-versions of exhibits to school classrooms
- Mobile vans for digital multimedia production and special exhibits
- Museum and school science fair exhibits in shopping malls (e.g., Science Palooza, sponsored by the Synopsys Outreach Foundation)
- Collaborative research with faculty and students at colleges and universities, as well as joint curriculum development

Mark St. John and Inverness Associates (1996a, 1996b) noted how museums are an important—and largely unrecognized—part of the educational "infrastructure" in America:

> *Just as the soundness of the economy depends on the quality of the underlying infrastructure, so the soundness of the educational system depends on its underlying physical and intellectual infrastructure…[museums and other institutions of informal science*

> *education are] a largely unrecognized piece of that educational infrastructure." Their national survey documented the contributions of a variety of institutions of informal science education, including: science museums, aquariums, botanical gardens, zoos, arboretums, natural history museums, planetariums, and science-rich children's museums.*
>
> (Inverness Associates/ASTC, 1996a)

Given the relative poor performance of American students on science learning, per the Third International Measurement of Mathematics and Science (TIMMS), and the especially poor science achievement performance of California's students on the recent National Assessment of Educational Progress (NAEP), St. John has suggested that this national science education "infrastructure" of informal science learning centers is a vital requisite to developing a population that is scientifically literate Because the recent California State Science Curriculum Framework has acknowledged that the primary focus of many California elementary schools has been to improve reading, language arts and mathematics achievement, we are now faced with the unfortunate fact that many California teachers don't even teach science in their classrooms because they feel they don't have enough time (or background) to support effective science learning for elementary (or even middle) school students. Under these conditions, the "invisible infrastructure" of informal science centers in both the San Francisco Bay Area, as well as across California, may become the most important untapped resource we have to help improve student science achievement, especially in grades K-8.

Because the San Francisco Bay Area has long been one of the leading national and international communities of multiple major science learning institutions, as well as active research and support of science education, the Inverness Research national survey (done for the Association of Science-Technology Centers (ASTC) from 1994-1996), presents a summary set of findings that seem especially relevant—and a call to action—for exploring how we can leverage these institutional resources for improved student learning and teacher professional development in this region. Following is a synopsis of this study's major findings from across the country. (Inverness Research Associates, op cit., 1996a)

Note: This summary represents the results of 440 respondents nationally from 1,361 surveys distributed (32% response rate). Individual institutional or aggregate data for only Bay Area museums and informal science centers is unfortunately not available; however, for a number of reasons addressed in this report, we recommend that the Hewlett Foundation and other local foundations support getting such data now as both a timely and a strategic tool in assessing both the current state of activities in our area, as well as exploring how new and emerging digital media and communications technologies might help leverage access to and use of these learning resources for Bay Area schools:

(a) Informal science-education institutions serve schools on a national scale. There are over 1,500 institutions in the U.S. whose mission is to promote informal science learning, ranging from science and technology museums, and natural history museums to zoos, aquariums, planetariums, children's

museums, and nature centers (Note: This study did not address the mass media resources for science learning provided by PBS, NPR, and commercial television channels such as The Discovery Channel. This report was also prepared just as the World Wide Web was developing from a small research community into the global knowledge communication and commercial resource we have today).

(b) School programs are a priority. Approximately 75% of all responding informal science learning institutions have active programs that serve their local schools. They devote an average of $30,000/year (5% of their overall operating budgets) to school programs.

(c) School programs are funded from local sources. Approximately 80% of all funds for school-support programs (including fees, grants from local agencies, and related museum operating funds) come from local sources.

(d) Informal science-education institutions focus on elementary schools. Over 90% of informal science-education institutions focus their primary efforts in school-related programs on elementary schools and teachers; only 10% said their primary focus was on high school teachers.

(e) Informal science-education institutions provide many forms of support for science education. These include many different types and levels of professional development for teachers, including assistance with curriculum and materials. Most offer workshops, both one-day and multiple-day (e.g., summer), coaching for teachers, and assistance with science kits or curriculum development. About 20% offer intensive multi-week teacher professional development institutes, internships or pre-service programs.

(f) Informal science-education institutions serve many teachers each year. Nationally (1995), over 150,000 teachers were engaged in teacher education and professional development events conducted by informal science-education institutions each year. This represents approximately 10% of the total teacher population. 20% of all U.S. elementary school teachers who participate in science educational programs do so at/through these institutions.

(g) Many programs provide in-depth learning experiences for teachers. About 27,500 teachers participate annually in in-depth professional development programs, such as institutes and institute follow-ups. For those elementary teachers who participate in more than 35 hours of science-based professional development, 40% do so at informal science-education centers.

(h) Many institutions offer internships and residencies. About 1,000 teachers each year are serving in some form of residency or internship at science museums and other informal science-education centers.

(i) Many institutions of informal science education provide pre-service activities. Approximately 10,000 teacher candidates participate annually in a diverse set of pre-service activities at science-education institutions. Nearly one third of all science-education institutions offer pre-service educational activities.

(j) Informal science-education institutions are serving schools with large numbers of underrepresented students. Institutions of science education provide services equally to schools with student populations from low, middle and high percentages of students from ethnic groups who are underrepresented in science. Nearly one third of all these institutions serve a majority of schools with underrepresented student populations.

V. Educational Partnerships Between Museums and Schools

Diane B. Frankel, former Director of the Institute of Museum & Library Services (IMLS) in Washington, D.C. and now a Program Officer at the James Irvine Foundation in San Francisco, was a key co-author of an important IMS report, "True Needs, True Partners: Museums and Schools Transforming Education (IMS, 1996)." This report profiled 15 exemplary and collaborative partnerships between museums and K-12 education, as well as identifying both common themes and principles for successful collaborations. As Frankel stated in her overview:

> *The common thread is this: when a partnership is developed [between museums and schools] in response to an expressed need, the result is transformative. Teachers, students and museum educators never think about learning in the same way again…*
>
> *True collaborative programs that involve partnerships blessed at the highest levels of both institutions are beginning to emerge everywhere. As museum educators respect school educators as equals, they have become more sensitive to developing programming that applies directly to what is happening in the classroom. As teachers watch students who have problems with traditional learning models come alive in museums, they find new ways to reach these students. As directors and board members view education as a core principle of a museum, they endorse and actively support the formation of long-term relationships with schools. In the ultimate partnership, a number of museum schools have opened, and many more are on the horizon. Technological advances, which are having a strong impact on the way we are educating our youth, also have tremendous potential to enrich museum-school partnerships.*
>
> (IMLS/Frankel, Ibid)

This report, the result of a series of planning grants and the selection of 15 out of 300 applications for Museum Leadership Initiative grants by IMLS in 1994-1995, provides a

framework of principles for creating and sustaining successful partnerships between museums and schools. Some of the foci for these partnerships were based on grade level of schools involved, e.g. preschools, elementary, middle and high schools; museum schools, urban schools, rural school schools. Some were based on content or professional development: curriculum development, professional development, resources for teachers; exhibitions, software development, interactive television. And other aspects included needs assessment, museum-school coordinators, parent and community involvement, and museum education research.

The conditions for success for these partnerships are summarized below. (IMLS, Ibid) These success conditions may form the foundation for exploring possible San Francisco Bay Area partnerships, both among different science museums and informal science education programs, and partnerships between the museum community and the schools—especially teachers, students, and parents living and working in under-served urban communities:

1 Obtain early commitment from appropriate school and museum administrators.
2 Establish early, direct involvement between museum staff and school staff.
3 Understand the school's need in relation to the curriculum and state and local education reform standards.
4 Create a shared vision for the partnership, and set clear expectations for what both partners hope to achieve.
5 Recognize and accommodate the different organizational cultures and structures of museums and schools
6 Set realistic and concrete goals, through a careful planning process. Integrate evaluation and ongoing planning into the partnership.
7 Allocate enough human and financial resources
8 Define roles and responsibilities clearly.
9 Promote dialogue and open communication.
10 Provide real benefits that teachers can use.
11 Encourage flexibility, creativity, and experimentation.
12 Seek parent and community involvement.

The principles and success criteria identified by Frankel in this report have led to a collaborative initiative of the James Irvine Foundation in funding a number of California museums to partner with K-12 schools in a program called The Museum Youth Initiative. (see Appendix B)

VI. Opportunities for Collaboration and Leverage Profiles of Some Leading San Francisco Bay Area Informal Science Education Institutions

The collaborations [between museums and schools] were fun, cost effective, and the end result was a great project. We took the strengths of each individual partner and together we built a better program than any of us could have alone.

--Judy Scotchmoor, U.C. Museum of Paleontology

Nothing new that is really interesting comes without collaboration.

--Francis Crick, Nobel Laureate and co-discoverer of the double helix structure of DNA

The greater San Francisco Bay Area is one of the richest resources of museums, zoos, and other informal learning programs in the U.S, if not the world. There are over 100 museums, as well as zoos, scores of public libraries, and many other forms of out-of-school learning. If we also include art galleries, theater, and concerts, as well as summer camps, internships, and as well as the extensive resource of public radio, PBS and commercial television (e.g., The Discovery Channel) and the web, this combined resource could be seen as a massive curriculum resource for the Bay Area's 1 million K-12 students, as well as their teachers and parents, with a cumulative aggregate investment in the billions of dollars.

In surveying and interviewing key people at Bay Area science-technology museums and informal learning programs, we reached the following conclusions regarding the issues and questions we addressed in this study:

- Collaborations between science-technology museums, higher education institutions, and other informal learning institutions with Bay Area teachers, students, and schools have a long history, especially in the areas of federally-funded science-mathematics and technology education curriculum development, school visit programs, summer professional development workshops for teachers, and after-school/weekend/summer courses for students.

- The leading large science-technology museums, aquariums, and zoos in this region have had—and continue to have—collaborations with other museums and institutions all over the U.S, as well as overseas. The most common local collaborations among multiple institutions are usually those involving development of new curriculum or new digital media/technology approaches to expanding public outreach or access. Such collaborations are usually led by one key institution, in partnership with other museums or informal learning institutions. However, local deep collaborative projects among several of these museums that are programmatically linked with partnerships of one or more major school districts are rare—for mainly economic, organizational, logistical and technology related reasons.

- Despite the fact that many of these Bay Area institutions have worked with thousands of Bay Area K-12 teachers over the past 30+ years, many teachers in the classroom today still do not see (or cannot effectively access or use) the exhibits or science education resources of these institutions as central to their curriculum needs. For reasons of cost, logistics, and other reasons, they tend to make very few visits with their students to these museums each year (other than for an occasional field-trip); this is especially true for lower-income, under-served school communities.

- Collaboration among these institutions While each of these institutions have partnerships or programs targeted to Bay Area teachers and schools, a major focused collaboration among many of these different museums to better leverage one another's resources, as well as to better serve the needs of local urban and under-served students, is rare.

One way to view the educational potential of San Francisco Bay Area museums and other informal science education institutions is as a distributed network of core competencies and learning resources. Each institution or program has its own culture, history, talent pool, and intellectual and relationship capital with its visitors and funders. These competencies and resources can potentially be brought together as part of an inter-institutional collaboration. With the aid of current and emerging digital technologies, such collaborations can potentially provide synergy—a set of experiences or resources that are greater than the sum of each individual institution's resources that leverage and extend what each individual institution can provide. Or, in some cases, such collaborations can also be disappointing to the participating institutions. One of the key Bay Area science educators interviewed attributes reluctance to engage in more regional institutional collaborations to be a result of "primate behavior"—driven by needs for preserving institutional identity, fear of loss of one's funders, or the need for spending increased time and resources (both scarce in these institutions) in order to make these collaborations effective.

Michael Schrage, author of *Shared Minds* (now republished as *No More Teams*) has written for many years about the potential value of the Internet and many digital technologies for supporting collaboration (Schrage,, 1990, 2000). Schrage says that the best case collaborations are a response to a desire or need to solve a problem, create, or discover something within a set of constraints. These constraints include: expertise, time, money, competition, and conventional wisdom. Given these constraints, collaboration is not routine or predictable—in fact, people collaborate because "they don't know how to—or can't— deal effectively with the challenges that face them as individuals." (Schrage, Ibid, pp. 36-37) These same comments can be applied to institutions such as science museums and the schools in collaborating with one another.

We feel that the growth of new kinds of digital media and telecommunications technologies, especially the new Intenet2 and the Digital California Project, might enable a kind of Bay Area networked science, math, technology and engineering education

"collaboratory" which could become one of the best learning and professional development resources in California, as well as the nation.

Some of the key questions addressed by this study include:

- How often do Bay Area museums and other informal science education institutions collaborate locally or regionally with one another in partnering or serving the needs of Bay Area schools?

- Are there models in which such collaborations have been successful?

- Can current and emerging digital media and telecommunications technologies enable more effective local collaborations?

Below is a brief summary of some of the leading science museum and other informal science education programs in the Bay Area, highlighting some of the core competencies of each institution, as well as some of their collaborative relationships with schools and higher education partners, as well as with other regional, national or international partners. The information here is not comprehensive, but rather, it is designed to give a "snapshot" of some current and recent past collaborations, as well as opportunities for the future. We propose that this group of institutions, as well as other emerging collaborations, become the hub of a science educational "collaboratory" or learning network to leverage each institution's strengths and core competencies, as well as to provide the best synergy of learning and professional development resources to teachers and students in Bay Area schools (For more information on the programs of these institutions or projects, see Appendix C).

Table 1: Overview of Key Museum Resources

Institution	*Synchronous or Asynchronous*	*Co-located or Distributed*	*Collaborating Partners*	*Key Target Audience*
Exploratorium Live @ Exploratorium	Synchronous Webcast; asynchronous archive	Live event at Exporatorium, but also distributed	NASA, other partners	General public (remotely); museum visitors & school groups (onsite)
Exploratorium Center for Informal Learning in Schools	Both; synchronous conferences, workshops, & research; asynchronous participation	Distributed, but sometimes co-located	U.C. Santa Cruz Kings College, London	Graduate students (M.A. and Ph.D.) in informal science education; teachers; other museum educators
Lawrence Hall of Science Science Curriculum R&D Projects (e.g., GEMS, FOSS, etc.)	Both	Major team efforts at LHS; distributed testing and development at school sites	Various individual teachers, schools and school districts (both Bay Area and national)	Classroom teachers
The Tech Museum The Tech Challenge	Both	Both: Live event at the Tech; teams work offsite to solve design challenges, with parent or teachers as coaches	Regional K-12 school districts; support of business and industry.	Students; Design challenges used as bases for teacher workshops and development of curriculum
Leadership Institute for Teaching Elementary Science (LITES)	Mostly synchronous.	Teachers met together (co-located) at many different museums and informal learning institutions	Many, including: Mills College + Oakland Museum, Chabot Space & Science Center, Oakland Zoo, San Francisco Insect Zoo, Lindsay Wildlife Museum, U.C. Botanical Gardens, regional parks, etc.	Teachers: Professional and leadership development in elementary school science.

Two scenarios for collaboration:

- Suppose teachers in multiple school districts around the Bay Area wanted their students to understand more about light—specifically, what is light, the duality of light as behaving as both a particle and a wave, what the electromagnetic spectrum is, and what lasers are and how they can be used to analyze both the smallest particles and the nature of planets or stars.

- Using James Burke's "Knowledge Web" as a guided discovery of different linkages between people, ideas, inventions, and scientific principles. (Burke, *et al*, 2002; Burke 1999). Construct web-based and onsite journeys through the resources of multiple Bay Area museums using *people* in history and contemporary science and technology as the key "connecting" points. For example, look at all the different exhibits and resources of the Exploratorium beginning with Leibniz –how was he connected to a wide variety of available exhibits on different phenomena—and what other people were part of his knowledge web of connections? Do the same for the Tech Museum, Chabot Space & Science Center, California Academy of Sciences, etc.

Given the institutions below, consider how an average middle school teacher or parent would go about finding the best available resources from several or all of the museums and informal learning programs below. How could student or classroom visits be structured so as to give students a rich view of what light is all about, while still having teachers address the science education standards for which they are accountable? How might different students and teachers make use of these different institutions in a synergistic way so that collaborative research projects and insights could be shared with other participating schools?

VII. Toward a Bay Area Science, Mathematics, Engineering and Technology Lifelong Learning Collaboratory

Leveraging the Web and Digital Convergence

Bay Area science-technology museums have been pioneers in the use of computers and digital media for informal interactive learning and technology education for over 30 years. For example as early as 1971, the Lawrence Hall of Science was one of the few museums in the world to offer public access to using and learning to program computers, as well as for hands-on exhibits, school visits, and after-school and summer classes for students. LHS also pioneered the use of mobile vans, equipped with Apple IIe and Atari home computers for school use in the late 1970's and early 1980's, and the California Academy of Sciences was the launch site of "Creativity: The Human Resource" in 1979, a traveling exhibit sponsored by Chevron Corp. and ASTC— and one of the earliest museum exhibits to make major use of early microcomputers for interactive exhibits.

The Exploratorium has had a major role in co-developing new uses for computers and new digital interactive media in a hands-on museum. Through a major partnership with Apple's Multimedia Lab and Lucasfilm. Ltd. in the 1980's, a number of early prototypes of interactive video, CD-ROM and use of digital video were designed for both public access in the museum, as well as K-12 classroom use. Since the birth of the web in the 1990's, the Exploratorium and other Bay Area museums have been among the first to incorporate the web as a major remote access resource to curriculum and interactive exhibits. More recently, through its Center for Media and Communications, the Exploratorium has developed public events around the use of multimedia, Internet-based videoconferencing (e.g., CU-See Me), and live webcasting and archiving of special science-related news events, such as the last solar eclipse of the 20th century, an event that was seen by millions of remote viewers on both the web and picked up by major television broadcast networks (http://www.exploratorium.edu/eclipse/).

A wide variety of technologies have now been in common use at museums for many years. These include audio tours (cassette and CD-based), videodiscs and CD-ROMs, large screen projection systems (and the even larger IMAX theaters), live videoconferencing and "telepresence," individual and networked multimedia computers (as well as multimedia labs) both for specific exhibits, browsing the web, and for providing classes for students and teachers on programming, using technology and multimedia tools, and for content-related workshops and courses. Other informal science learning institutions and programs have also used email, listservs, and online discussion boards and groups to exchange ideas and to collaborate with one another on specific projects.

During the last few years, the web has become one of the most rapidly growing technologies in use by museums. A dedicated conference called "Museums and the Web" (Archives and Museum Informatics, 2000, 2001) is now in its sixth year, and over 120 papers, presentations and demonstrations were given at last year's conference (http://www.archimuse.com/mw2001/). In addition to providing remote access to information about museum programs and exhibits, the web has rapidly become a source of curriculum, professional development links, and interactive learning experiences for students and teachers. Web sites such as http://www.TryScience.org (sponsored by IBM), the Science Learning Network http://www.sln.org, http://www.ScienceAdventures.org, and http://www.ExploreScience.com all have links to multiple museums and online learning experiences in science and technology—and http://www.MathForum.org and http://www.ExlporeMath.com similarly have excellent interactive learning activities for mathematics (Some of the other web-based technology resources and exemplary collaborative educational projects utilizing some of these resources may be found in Appendix D and Appendix E).

Through the development of database-driven web technologies, interoperable "learning objects," and the digital convergence of multimedia, video, audio, voice, text, animation and graphics, the web is now becoming both a source of media-rich learning content, as well as a new medium for collaboration. Tom Kalil, former Director of the National

Economic Council, has called this "leveraging cyberspace"—the access and use of distributed information and computing resources available all over the world that can be harnessed to solve problems in science, engineering, mathematics, and other areas that were previously thought to be impossible to address (Kalil, 1996).

Similarly, we are seeing a growth of "broadband" high bandwidth network technologies being deployed in schools and homes, such as DSL and cable modems, as well as wireless technologies such as cell phones and relatively inexpensive handheld, computers and PDAs with access to the Net. The increase in broadband networks has made streaming media webcasts (both live and archived) much more widely available than in the past. There are also advanced technologies such as 3D virtual reality and "immersive environments," "wearable computers," and even "digital paper" in which common surfaces and materials may become digitally re-configurable and accessible through small wireless transmitters.

The challenge for museums and informal learning institutions is to find the most effective ways to use these technologies to enrich both live interactive learning experiences onsite at museums and informal learning institutions, as well as to provide remote access to such experiences for students, teachers, parents, and members of the community who cannot visit museums frequently.

A variety of alternative future scenarios of how different technologies may be used for learning and education has been done by many groups, including a recent futures or "vision map" exercise, "Educational Technology Horizon: 2001-2010," sponsored by the U.S, Department of Education, in collaboration with the Grove Consulting Group and the Institute for the (see http://www.grove.com/doed/background.html). Of the many different technologies and digital convergences available, the following seem to hold great promise:

- Portable, inexpensive handheld or wearable computers and PDAs

- Web-based "guided tours" involving multiple and linked interactive learning experiences from multiple museums, linked with curriculum standards and alternative assessment strategies for teachers (e.g., http://www.techscape.org/mp/welcome.html)

- Annotated digital video, both streamed on the web and distributed via CD and DVD

- Multi-User Virtual Environments (e.g., http://www.activeworlds.com and http://www.tappedin.org in which multiple learners and teachers can explore spaces from a remote geographic map to the insides of a molecule on the web together

- Peer-to-peer technologies, such as AOL's Instant Messenger (AIM), peer-to-peer file-sharing (such as MP3) and just-in-time collaboration online (e.g., http://www.groove.net)

The key to successfully planning and integrating these various technologies for informal learning is in how they will best serve to help build, support, and sustain online communities of learners, teachers, and science/math content experts and practitioners (Kahn, 1999a, Kahn 1999b). This is also where we feel some of the greatest potential lies in leveraging the individual core competencies, resources, and expertise of individual science-technology museums and other providers in bringing together a much richer learning experience for students, parents and teachers than any one institution could provide on its own.

VIII. Conclusions

The focus on science-technology museums and related informal science education institutions and programs in the Bay Area resulted in the following findings:

- **Science institutions and K-12 schools collaborate.** The most common forms of collaboration or partnerships between informal science institutions and the local K-12 schools are: school visit programs, teacher professional development workshops, educational outreach programs in the schools, student docent/internship programs (mostly high school students) and after-school or summer classes, events, and summer camps for students.

- **Multiple organizations on local, state, and national levels collaborate.** Curriculum development, teacher preparation, and professional development projects, such as those funded by the National Science Foundation and the U.S. Department of Education, are the main kinds of collaborations involving multiple local (and other) partnerships and collaborations. Special events, such as live webcasts (e.g., Live@ Exploratorium) or the Jason Project broadcasts, also frequently involve two or more partners, as well as the schools.

- **Major national or international collaborations are more frequent and visible than sustained local collaborations.** Major national or international collaborations, such as the recent Center for Informal Learning and Schools (CILS) and web-based collaborations such as the IBM-funded http://www.TryScience.org or the Eisenhower Regional Consortia's http://www.ScienceAdventures.org, are more frequent—and often much more visible— than sustained local collaborations between multiple museum and informal science learning providers. Also, there are many smaller informal science learning institutions and programs that need much more visibility to Bay Area teachers in terms of their resources and programs.

- **Science curriculum-related resources from informal science institutions are underutilized in classrooms.** Despite the fact that thousands of Bay Area teachers have visited various museums and informal science programs, either with their students or as participants in teacher professional development workshops, it is clear that there is little use of the exhibits and other available science curriculum-related resources from these institutions in daily instruction in the classroom.

- **School visit programs to museums and other institutions are infrequent.** School visits to museums and other institutions take place primarily with elementary schools, and occasionally, with middle schools. Such visits with students to any given individual institution may occur once a year, and these visits are even more rare in under-served communities.

- **Few coordinated efforts have been made to connect Bay Area teachers and existing classroom curriculum with informal science learning resources and programs.** With one or two exceptions (e.g. the LITES science education institute for elementary teachers in Oakland), few coordinated efforts have been made to introduce Bay Area teachers to the wealth and diversity of the informal science learning resources available onsite at each of the Bay Area museums and other informal science learning programs and next to no effort has been made to systematically align these resources with the science curriculum these teachers teach.

- **Teacher use of web-based science curricula, materials, and opportunities is limited.** The Web has created a much more visible presence for the kinds of curricula and supplementary science learning resources, as well as professional development opportunities at most of the Bay Area museums and informal learning programs. However, it appears teachers (and their students) make little use of these resources.

- **Museums and informal learning programs appear interested in the development of sustainable collaborations.** The key to success of such collaborations is to provide ways in which each institution's unique core competencies and assets can be leveraged and can complement those of other institutions to provide a synergy of resources and experience to teachers, students, and parents. The use of the web as a resource, coupled with a coordinated programmatic content development effort—one which easily provides alignment of activities and resources with science education standards—is seen as a particularly effective way to accomplish this kind of collaboration.

IX. Recommendations for Action by the Hewlett Foundation

This exploratory study shows that the San Francisco Bay Area has a wealth of leadership science and technology museums and other informal science education institutions and

programs whose collaboration could potentially provide great leverage for each of these separate institutions while also benefiting Bay Area K-12 school communities—including teachers, students, parents, educational researchers, and members of the community. We are living in a time when the half-life of information and scientific knowledge keeps decreasing, while the amount of new data and information about science (and even totally new fields of pure and applied scientific research) is expanding far beyond our capability to absorb and effectively utilize this growing knowledge asset. At the same time, our state severely lacks enough qualified and adequately-trained science teachers to serve the needs of our students, especially in the elementary and middle grades—and even more so in under-served communities. Good (or potentially excellent) science teachers often leave public education within five years of their acquiring their teaching credential, and in some cases, turnovers of upwards of 50% of the total faculty in some large districts may be retiring within the next 3-5 years.

Given this situation, we feel it is important for foundations like the Hewlett Foundation to take a leadership role in encouraging, promoting and helping scale active learning and professional development resources provided by science and technology museums, zoos, aquariums, and other informal science education institutions and programs. This is especially important at this time, when Silicon Valley is still plagued by an economic recession and high unemployment, both of which have translated into substantially reduced funding sources for the non-profit and education sector—just at a time when we most need these resources to improve our students achievement in mathematics, science and technology education in K-12 schools.

1. Create the infrastructure to support collaboration and partnerships between informal science institutions and the local K-12 schools:

- **Support collaborations among Bay Area informal science institutions and local K-12 schools.** Create a study based on the methodology used in the 1996 ASTC national survey, but aligned to the resources and educational opportunities in the Bay Area. Include in this survey the current use of various technologies including the web, by these institutions to support both improved user exhibit experiential learning, better remote access, enhanced educational outreach.

- **Support a pilot project to select, inventory, and catalog existing web-based interactive learning opportunities from key museums and informal science education programs.** Programmatically link one or more of the "big ideas" from the National Science Education Standards so that each "learning object" would be aligned with both California state science curriculum standards and frameworks, and combined with learning guides to facilitate access and use. An increased number of teachers would have access to the experiences and resources available from different museums and informal learning programs help students learn "the big ideas" in science, as recommended by the National Research Council and AAAS, as well as by the California Science Standards. (Preliminary inquiry letter submitted to Hewlett Foundation, January 17, 2002)

- **Support a pilot program to demonstrate the effective integration of multiple technologies to engage museum- and center-goers and extend the experiences of students and teachers.** These technologies could range from low-cost, handheld wireless devices (such as web-accessible PDAs or smart toys) to wireless laptops, small digital video cameras and webcasting facilities, to high-bandwidth, highly-immersive advanced-learning environments that can showcase exemplary use of distance learning, telepresence, simulation and visualization as means for cross-institutional collaboration in science learning. Bay Area museums and informal/formal science education providers who are creating interactive learning experiences for various museums and informal learning intuitions would co-design the pilot program. Teachers and students may continue or extend an experience after having visited one of these institutions, either on the Web, through remote access to video or distance learning presentations, or through handheld computer explorations, both in schools and at home.

- **Provide transportation and "visitation" grants to schools and school districts**. Encourage and enable teachers and students, especially those attending underserved schools, to visit Bay Area museums and informal learning institutions much more frequently during each school year. This activity would help to accelerate the adoption of the two pilot programs identified above.

2. Develop and support a learning community

- **Provide fellowships for teacher collaboration with museums**. Enable teachers to work with museum staff to create educational components of current and planned exhibits and link existing school curriculum to the work of the institutions. Fellowship activities could take place during summer vacation or a few days per week during the school year.

- **Convene a meeting of key science museum educators and other science center directors in the Bay Area**. Include the key foundation program officers who are actively supporting science educational reform efforts in Bay Area schools and museums. Use the concept of creating a networked Bay Area Science Mathematics, Engineering and Technology Lifelong Learning Collaboratory as the focus for such a conference, and encourage the participation of the smaller organizations and centers in the region. Extend this dialog and continuing the building of this community through Collaboratory meetings at existing conferences and activities of groups such as BASA and others (e.g., the California Science Teachers Association and National Science Teachers Association conferences, The Exploratorium/CILS' Fall Institute, etc.)

- **Design a new kind of charter school**. Build around the exhibits, lesson plans, professional development activities, and other learning resources of Bay Area BASA members. Work collaboratively with a group of representatives of the science-museum and informal science learning community, including the staffs of

CILS (Exploratorium), the Noyce Center for Learning, Bay Area participants in the CORAL and Youth Museum grant programs of the James Irvine Foundation, and groups such as BASRC and the Coalition of Essential Schools to develop an initial planning process to harness and leverage the extensive science education resources of these institutions as central to the teachers' practices in this new kind of school.

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APPENDIX A: Greater San Francisco Bay Area Museums and Informal Learning Centers/Programs for K-12 Students and Teachers

Note: This list includes not only science-technology centers, but also other kinds of museums and informal learning programs in the San Francisco Bay Area, as well. See also information about BASA in Appendix C for a more targeted list of science education and informal science/math/technology learning institutions and programs.

Berkeley
Berkeley Art Museum + Pacific Film Archives
http://www.bampfa.berkeley.edu/education/
Habitot Children's Museum http://www.habitot.org
Hall of Health http://www.hallofhealth.org
Judah Magnes Museum http://www.magnesmuseum.org
U.C. Berkeley http://www.berkeley.edu (also UC Office of the President: k12.ucop.edu)
Center for Digital Storytelling (UC School of Education) Berkeley/Albany
http://www.storycenter.org
COSMOS (summer U.C. camp for math/science high school students)
Essig Museum of Entomology http://www.mip.berkeley.edu/essig
Lawrence Berkeley Labs http://www.lbl.gov/Education/
Lawrence Hall of Science http://www.lhs.berkeley.edu/iu/lhs.html
Phoebe A. Hearst Museum of Anthropology (UC)
http://www.qal.berkeley.edu/~hearst/
UC Botanical Garden http://www.mip.berkeley.edu/garden/
UC Museum of Paleontology http://www.ucmp.berkeley.edu

Clayton/Danville
Mitchell Canyon Interpretive Center (Mt. Diablo State Park) http://www.mdia.org/events.htm

Museums at Blackhawk (U.C.)
Automotive Museum http://www.blackhawkauto.org
Cyberspace Museum of Natural History and Exploration Technology
http://www.cyberspacemuseum.com/n5_4.html

Davis
Explorit! Science Center http://www.dcn.davis.ca.us/GO/EXPLORIT
U.C. Davis http://www.ucdavis.edu
R. M. Bohard Museum of Entomology http://entomology.ucdavis.edu/dept/bohart.html
UC Davis Arboretum http://arboretum.ucdavis.edu/about.html
UC Davis Herbarium http://herbarium.ucdavis.edu/
Museum of Wildlife & Fisheries Biology
http://www.wfb.ucdavis.edu/www/museum/museum.html

Fremont
Math Science Nucleus http://www.msnucleus.org

Livermore
Lawrence Livermore National Lab http://ep.llnl.gov
Sandia National Laboratories http://www.sandia.gov

Los Gatos/Saratoga
Vasona Discovery Center and Youth Science Institute http://www.ysi-ca.org/welcome.html
Villa Montalvo http://www.villamontalvo.org

Menlo Park/Stanford University
US Geological Survey (USGS) http://www.usgs.gov
Cantor Center for the Visual Arts/Stanford Museum of Art
http://www.stanford.edu/dept/SUMA/
Stanford Linear Accelerator Center (SLAC)
http://www.slac.stanford.edu/gen/edu/education.html

Marin County/Sausalito/Petaluma
Bay Area Discovery Museum (Sausalito) http://www.badm.org
San Francisco Bay Model Visitor Center (Sausalito)
http://www.spn.usace.army.mil/bmvc
Headlands Institute - Yosemite National Institute (Sausalito) http://www.yni.org/hi/
Marin County Historical Society & Museum http://www.marinhistory.org/museum.htm
Petaluma Wildlife and Natural Science Museum
http://www.caohwy.com/p/petawnsm.htm
WildCare: Terwilliger Nature Education and Wildlife Rehabilitation
http://www.wildcaremarin.org

Monterey Bay Area
Maritime Museum http://www.mntmh.org/maritime.htm
Monterey Bay Aquarium http://www.mbayaq.org
Monterey County Youth Museum (MY Museum) http://www.mymuseum.org
Monterey Museum of Art http://www.montereyart.org
Pacific Grove Museum of Natural History http://www.ppgmuseum.org

Morgan Hill
Wildlife Education and Rehabilitation Center (WERC)
http://www.berryessa.k12.ca.us/fieldtrp/werc.htm

Mountain View/Los Altos
Digital Clubhouse Network http://www.digiclub.org
Foothill College Observatory http://www.foothill.fhda.edu/ast/fhobs.htm
NASA Ames Research Center Moffett Field http://www.arc.nasa.gov and
http://www.arc.nasa.gov/kids.html (includes NASA Ames Aerospace Encounter, NASA Space Camps, Teacher Resource Center, the new Computer Museum and forthcoming Aerospace Museum (Smithsonian National Air & Space Museum West)

Napa Valley
Napa Valley Museum http://www.napavalleymuseum.org

Oakland
Chabot Space and Science Center & Observatory http://www.chabotspace.org
Junior Center of Art and Science
http://www.oaklandnet.com/parks/facilities/points_junior_center.asp
Rotary Nature Center and Waterfowl Refuge
http://www.oaklandnet.com/parks/facilities/centers_rnc.asp
Oakland Museum of California
http://www.museumca.org/global/education/programs.html
Western Aerospace Museum Oakland http://www.aerospace.org/wamhome.htm

Palo Alto
Environmental Volunteers http://www.evols.org
Palo Alto Junior Museum & Zoo http://www.city.palo-alto.ca.us/ross/museum/
Peninsula Conservation Center Foundation http://www.pccf.org/aboutPCCF.html

Redwood City/San Carlos
Marine Science Institute http://www.sfbaymsi.org
Hiller Aviation Museum http://www.hiller.org

Sacramento (see http://www.sacmuseums.org)
California Military Museum http://www.militarymuseum.org
California State Capitol Museum http://www.tfaoi.com/aa/1aa/1aa184.htm
California State Indian Museum (and State Parks Museum Resource Center)
http://www.parks.ca.gov/allpages/default.asp?page_id=885
California State Railroad Museum http://www.csrmf.org
Crocker Art Museum http://www.crockerartmuseum.org
Discovery Museum http://www.thediscovery.org/home.html
Golden State Museum http://www.ss.ca.gov/museum/intro.htm
Governors Mansion (now listed under http://www.parks.ca.gov or
http://www.sacmuseums.org/governor
McClellan Aviation Museum @ McClellan AFB http://www.sacmuseums.org/mcclellan
Sacramento Zoo http://www.saczoo.com
CSU Sacramento http://www.csus.edu
Sutter's Fort State Historical Park http://www.sacmuseums.org/suttersfort
Towe Auto Museum http://www.toweautomuseum.org
Wells Fargo History Museum http://www.sacmuseums.org/wellsfargo

San Francisco (see also http://www.gocalifornia.about.com/cs/sfmuseum/index.htm)
Alcatraz Island Prison - SF Bay
Ansel Adams Center for Photography
Astronomical Society of the Pacific
California Academy of Sciences - Natural History Museum, Morrison Planetarium & Steinhart Aquarium http://www.calacademy.org

Cartoon Art Museum
Center for the Arts at Yerba Buena (see also The Zeum)
Children's Art Center of San Francisco http://www.childrensartcenter.org
Craft and Folk Art Museum
Exploratorium http://www.exploratorium.edu
Fine Arts Museum of San Francisco (de Young and The Palace of the Legion of Honor)
http://www.thinker.org
Golden Gate Railroad Museum http://www.ggrm.org
Jewish Museum San Francisco http://www.jmsf.org (under development)
Maritime Museum & National Maritime Museum
The Mexican Museum
Museum of the City of San Francisco
The Randall Museum
Ripley's Believe It or Not! Museum
San Francisco Computer Museum (four museums under development)
http://www.fog.com/sfcm/museums.html
San Francisco Museum of Modern Art http://www.sfmoma.org
San Francisco Zoo http://www.sfzoo.org
Strybing Arboretum & Botanical Gardens (in Golden Gate Park)
The Zeum http://www.zeum.org (see also Yerba Buena Center for the Arts

San Jose
Almaden Quicksilver County Park (including Quicksilver Mining Museum)
http://santaclaracounty.org/parks/
Children's Discovery Museum of San Jose http://www.cdm.org
Happy Hollow Park & Zoo http://http://www.happyhollowpark.org
Rosicrucian Egyptian Museum & Planetarium http://www.rosicrucian.org/mus-plan/0-museum.html
San Jose Center for Latino Art (MACLA) http://www.maclaweb.org
History San Jose (San Jose Historical Museum, etc.) http://www.historysanjose.org
San Jose Museum of Art http://www.sjmusart.org
San Jose Museum of Quilts & Textiles http://www.sjquitlmuseum.org
The Tech Museum of Innovation ("The Tech") http://www.thetech.org
(including new Robert N. Noyce Center for Learning)

San Leandro
Davis Street Environmental Education Center & Natural History Museum
http://www.fslc.org/edcntrvision.html

San Mateo
Coyote Point Museum http://www.coyoteptmuseum.org

Santa Clara
The Intel Museum http://www.intel.com/intel/intelis/museum
Triton Museum of Art Santa Clara http://www.tritonmuseum.org

De Saisset Museum (Santa Clara University)
http://www.scu.edu/SCU/Departments/deSaisset/

Santa Cruz and UCSC (http://www.ucsc.edu)
Santa Cruz City Museum of Natural History http://www.santacruzmuseums.org
Santa Cruz Museum of Natural History http://www.caohwy.com/s/sacrmunh.htm
LifeLab http://www.lifelab.org
Museum of Art & History http://www.santacruzmah.org
Seymour Marine Discovery Center at Long Marine Laboratory
http://www2.ucsc.edu/seymourcenter/lp-school.html
UCO Lick Observatory, Mt. Hamilton http://www.ucolick.org

Stockton/University of the Pacific (UOP)
Haggin Museum

Walnut Creek
Summit Museum at Mount Diablo
Lindsay Wildlife Museum Walnut Creek

Yosemite National Park
Yosemite Institute http://www.yni.org/yi

APPENDIX B: James Irvine Foundation

http://www.irvine.org/news/6_26_00_MYI.htm

FOR IMMEDIATE RELEASE
Date: June 26, 2000
Contact: Mark Sedway
Director of Communications
415-777-2244

THE JAMES IRVINE FOUNDATION LAUNCHES MUSEUM YOUTH INITIATIVE
Grants To Ten California Museums To Support Out-of-School Learning

San Francisco, CA–June 26, 2000: At its June meeting, the board of The James Irvine Foundation approved grants of $100,000 each to ten museums across the state participating in the Foundation's Museum Youth Initiative.

The museums will use the grants to provide educational programs to young people during out-of-school hours.

"These museums are pioneers in an ambitious experiment to find new places for California's young people to learn," says Diane Frankel, Irvine's Program Director for Children, Youth and Families. "We're excited to support them."

By deliberately linking out-of-school educational programs with what happens in local classrooms, the museums seek to increase the academic success of young people in their communities.

"In establishing the Museum Youth Initiative, we're recognizing that museums can play vital roles beyond their common charge," says Frankel, who served as Director of the United States Institute of Museum Services before coming to Irvine. "Museums can serve as valuable educational institutions. They can be close partners with local schools and communities. And they can be effective centers for youth."

The ten museums awarded the grants are located throughout the state, from Redding in the north to San Diego in the south to Lodi in the Central Valley. Each museum has undergone an assessment and planning phase and will use the grant money for first-year implementation of the four-year initiative.

California today is witnessing the spread of an ambitious new generation of educational reforms. Most focus on what happens during school hours.

The Museum Youth Initiative is part of Irvine's broad strategy to complement these efforts by mobilizing out-of-school resources in communities across the state to help

young Californians succeed in the classroom. Irvine believes that student achievement is a shared responsibility - of child, family, school and community. The Foundation therefore works to promote partnerships between schools and "informal" educational institutions, such as the ten museums participating in MYI, as a way to help kids learn.

The James Irvine Foundation is a private, nonprofit grantmaking foundation dedicated to enhancing the social, economic, and physical quality of life throughout California, and to enriching the State's intellectual and cultural environment. The Foundation was established in 1937 by James Irvine, the California pioneer whose 110,000-acre ranch in Southern California was among the largest privately owned land holdings in the State. With assets of $1.6 billion, the Foundation makes grants of approximately $75 million annually for the people of California.

APPENDIX C: Examples of Some Bay Area Science Museums, Informal Science Learning Programs, and Collaborations with Educational Institutions

The Exploratorium
San Francisco, CA
http://www.exploratorium.edu

Key Core Competencies: Inquiry-based science learning and design & effective use of interactive exhibits (both at the Exploratorium and exported to other museums around the world), extensive use of digital media and the web, teacher training and professional development (K-12), "artists in residence," and high school student (docent) explainer programs.

The Exploratorium is one of the world's leading science museums, one which has been actively promoting inquiry learning and which has helped to transform science and technology museums to be places of "hands-on" active learning for over 32 years. It houses over 650 exhibits linking science, perception, art, and discovery. These exhibits—and the understanding which Exploratorium staff and participating teachers have about their effective use for inquiry learning—form the central knowledge capital of this museum.

The Exploratorium has continued to receive large grants from the National Science Foundation in informal science education, as well as in teacher preparation and professional development. It was recently awarded a major $11 Million grant from NSF to establish an international Center for Informal Learning and Schools (CILS), in collaboration with University of California Santa Cruz and Kings College London.

Institute for Inquiry http://www.exploratorium.edu/IFI/
The Institute for Inquiry provides workshops, programs, on-line support and an intellectual community of practice for elementary teachers and science educators, centered around inquiry-based science instruction. Workshops and seminars are provided for district administrators, staff, curriculum coordinators, and K-5 teachers.

Center for Teaching and Learning (CTL)
http://www.exploratorium.edu/general.centers/CTL.html
The Center for Teaching and Learning was the first Regional Science Resource Center, designated by the California Department of Education in 1983. The teacher enhancement programs work with high school teachers from 65 California school districts, middle and junior high school teachers from 40 districts, and elementary school teachers from 30 districts. Each year the programs work with approximately 500 K - 12 teachers, directly reaching about 1,000 students in classroom co-teaching, and indirectly more than 50,000. The Center is also engaged in a formal partnership in the science education restructuring efforts of the San Francisco Unified School District and several school districts in Marin County. A major component of the restructuring effort is that each year four elementary

school teachers spend a one year residency at both the Exploratorium and at their district offices, training to become District Science Resource Specialists.

CTL includes six programs:

The Children's Outreach Program: Partnerships with community groups and social service organizations to provide educational services to young people and their families in underserved areas (primarily San Francisco and Oakland).

The High School Explainer Program: High school students are hired as "floor explainers" and are in charge of the museum floor and exhibits when the museum is open to the public. They are hired in groups of 25-35 three times a year for four-month semesters and provides over 60 hours of training to each explainer.

Field Trip Explainer Program: Adults from various backgrounds are available to lead children on field trips to a few exhibits, coordinated with "Pathways" curriculum packets available to teachers.

School in the Exploratorium: This program has worked with over 2,000 elementary teachers from San Francisco and Marin counties over the past 20 years in integrating science and art through investigating natural phenomena.

Exploratorium Teacher Institute: This professional development program concentrates on middle and high school science teachers using a "hands-on" approach to teaching of physics, general science, chemistry, mathematics, and teaching science where English is a second language. It involves both summer institutes and after-school workshops and has served over 600 teachers to date.

Center for Informal Learning and Schools (CILS): This new major NSF-funded center will collaborate with UC Santa Cruz and Kings College London to help develop leadership and research on informal science learning and the schools, both through helping establish graduate and doctoral programs in informal learning and science education, as well as promoting an international research community in this area of study (see summary of CILS below).

Center for Media and Communications
http://www.exploratorium.edu/centers/CMC.html

The Exploratorium has pioneered the use of new media and technologies(both one-to-one and many-to-one) for exhibits, providing educational outreach, and remote access and participation in active science learning and effective teaching. Its use of the web has been extensive, with a large online digital library of resources, as well as live and archived webcasts in a specially designed webcast studio.

Other Collaborative Programs: The Exploratorium has been a partner in the NSF-funded web-based **Science Learning Network** http://www.sln.org (involving the collaboration of 8 original museum partners and now expanded internationally, as well).

The Exploratorium is also now involved in a program in which different sets of its exhibits (and staff development expertise) are shared with other museum partners each year, both in the U.S, and around the world. The Rubin Fleet Museum in San Diego is one of its California partners in this program

Center for Informal Learning and Schools
A collaboration of the Exploratorium, UC Santa Cruz, and King's College London

Informal science settings offer compelling learning environments that can reach across age, socio-economic status, language, and gender gaps. The experiences found in these settings have a lot to offer the K-12 system. What is the nature of the environment, and its implicit and explicit pedagogy, that proves effective for so many learners? What can we learn about science education from these settings? How can we capitalize on the strengths of informal learning designs and strategies to help all K-12 students learn and want to learn science?

Purpose
The Center for Informal Learning and Schools (CILS) is a collaboration of the Exploratorium in San Francisco, the University of California Santa Cruz (UCSC), and King's College London (KCL). CILS is funded by the National Science Foundation, and other private and corporate foundations. CILS graduate programs, museum educator professional development programs, and research will focus on better understanding informal science learning to

- Develop new leaders in science education who understand how informal science institutions can interact with and contribute to K-12 science education reform
- Support the professional practice of informal science educators by strengthening their work with and support of teachers, students, and schools
- Develop a new body of research that examines how informal science settings can most effectively support formal science education, and advances learning research in general

The Center has, as one of its main objectives, an interest in exploring how a deeper understanding of informal science teaching and learning can support the learning of students from culturally and linguistically diverse populations in all settings.

CILS students will be enrolled at either UCSC or KCL, and will have opportunities to participate in exchanges between the two universities. A key feature of CILS is the annual Bay Area Institute, where all students, faculty, and invited guests will gather for two weeks each September to share practices, methodologies, and research findings. Together participants will forge a new field of inquiry, and connect research and practice in ways that strengthen the capacity and leadership of the field.

Tuition and stipends will be paid for all enrolled students who are residents of the U.S. (whether studying at UCSC, KCL or the Exploratorium). Students and educators from other countries are also invited to participate in the program, although at this point we do not have funding to support non-US resident students**.**

CILS Museum Educator Programs

• a 3-week professional development program at the Exploratorium focusing on exhibits as curriculum, informal learning, inquiry, design of informal education programs, the research basis for our work, and working with schools and teachers.

• a professional MA program (two consecutive summers) at UCSC and the Exploratorium, involving informal science learning theory, critical analysis of informal learning designs, and research based at students' home institutions.

CILS Graduate Programs

• a 4-year UCSC Education PhD program with an emphasis on how informal learning can support culturally and linguistically diverse learners in a variety of settings.

• a 3-year KCL Education PhD program with an emphasis on the nature of science learning, scientific discourse, and the role of informal science pedagogies in supporting science learning.

• a 2-year UCSC informal science learning focus for PhD candidates in the natural or social science disciplines.

CILS Research Programs

• research will be conducted by CILS faculty and graduate students at the Exploratorium and other participating institutions such as the London Zoological Society, the Monterey Bay Aquarium, the Ft Worth Museum of Science and History, the Seymour Marine Research Labs, and many others.

• research will also be conducted by museum educators enrolled in the MA or certificate programs at their home institutions.

Timeline

The first cohort of graduate students (PhD, post-doc, and MA) must apply to CILS in the fall of 2002 for enrollment at UCSC or KCL in the fall of 2003. There will be four cohorts enrolled at UCSC (2003-2006), and two at KCL (2003 and 2004).
All museum educators interested in attending the fall 2002 Informal Learning Certificate Program, should apply to CILS by February 2002. This program will be offered in each of the five years of the project.

Applications will be available in early 2002. For further information, please contact Bronwyn Bevan, Director Center for Informal Learning and Schools, at bronwynb@exploratorium.edu.

Lawrence Hall of Science
University of California, Berkeley
http://www.lhs.berkeley.edu

The Lawrence Hall of Science (LHS) is one of the oldest science museums in the Bay Area. It has been a pioneer and leader in the development of new approaches to science education and science curriculum development for nearly 35 years. It was also one of the first museums to provide public access to computers and computer-based learning and programming, dating back to 1971. It has also been an active research site and partner for both faculty and graduate students at U.C. Berkeley, including being a major learning community focus for interdisciplinary doctoral programs in science and math education, such as SESAME, which has produced a number of international leaders in this field over the past 25 years. Key internationally recognized science educators, such as Larry Lowery, Watson (Mac) Laetsch, Marcia Linn, and Marion Diamond, have all had LHS leadership or project-leadership roles with both research and development projects. These have been complemented by wide-ranging public education and professional development program.

A key core competency of LHS is its science and mathematics curriculum development projects and teacher professional development programs, in collaboration with Bay Area teachers. The development of this competency began with the leadership of the late physics professor and science educator, Robert Karplus, and his staff of the Science Curriculum Improvement Study (SCIS), one of the first major comprehensive science curriculum reform projects funded by the NSF in the late 1960's. This was followed by many other innovative science curriculum efforts for both use in schools, as well as homes and community learning environments. Following are some of the many

Instructional Materials and Related Professional Development Programs
http://www.lhs.berkeley.edu/edresources/

Curriculum and instructional materials developed at or in partnership with the staff of LHS are used in all 50 states and in over 20% of elementary schools. LHS professional development programs address compelling needs in science and mathematics education, and they link to a national network of teachers and educators who have been actively developing or using these materials.

http://www.lhs.berkeley.edu/profdev/TeacherInservice.html

ACCESS (Alliance for Collaborative Change in School Systems) A professional development program in mathematics that works in partnership with secondary schools preparing students, particularly underrepresented minority students, for challenging mathematics college-level work and for successful careers.

BASP (Bay Area Science Project) Staff development to strengthen science education. Affiliated with the California Science Project.

EQUALS and FAMILY MATH Inservice training and teaching materials that encourage students, particularly girls and underrepresented minorities, to pursue math-based study and careers.

Family Health Disseminates exciting hands-on health science activities and follow-up materials related to nutrition and growth, respiratory health, mental health and the brain, and disease prevention to participating schools in the Bay Area.

FOSS (Full Option Science System) Teaching materials for grades K-6 that emphasize real-world experiences in physical science, life science, earth science, scientific reasoning and technology.

GEMS (Great Explorations in Math and Science) A series of inexpensive step-by-step teacher's guides, workshops, and a national network that enables teachers to involve students in hands-on math and science learning.

HOU (Hands-On Universe) Hands-On Universe is an educational program in which students apply tools and concepts from science, math, and technology to investigate the Universe, using the Internet to download telescope images and analyze those images with user-friendly image processing software.

LHS Summer Mathematics Institutes Are designed to deepen teachers' understanding of the mathematics they teach in order to deal more effectively with how and what students learn. Teachers will see how mathematics builds on what came before and how it supports what comes after. The emphasis of these institutes is on improving teacher content knowledge.

MARE (Marine Activities, Resources and Education) A school-wide, interdisciplinary, thematic teacher training and curriculum program for grades K-8.

PEACHES Workshops for early childhood teachers, day care providers, and parents, enabling them to involve young children in hands-on science and math activities.

SEPUP (Science Education for Public Understanding Program) Instructional materials that highlight science concepts and processes associated with current societal issues.

Programs for school visits:
The following all include links to science standards.
http://www.lhs.berkeley.edu/pfs/

Assemblies: Science-on-stage presentation (for large groups).

Workshops for Students: Students become scientists, immersed in innovative, hands-on science and math activities (for all grades in earth science, life science, math, computers, and physical science).

Festivals: Involve the whole school community in science and math learning. Great for your open house or school fair.

Science Discovery Theatre: Live performances that deliver important science and math concepts with fun, humor, songs, stories, and audience involvement.

Multi-session Courses: Choose a course with the content you want as well as the dates, times, and number of sessions.

Field Trips: LHS is filled with interactive exhibits that support your curriculum with hands-on fun and learning.

The Tech Museum of Innovation
San Jose
http://www.thetech.org

Online Exhibits
http://www.thetech.org/exhibits_events/online/

The Tech's "hands-online" interactive museum…these exhibits explore the technology and science changing our world today. One example is robotics, a rapidly growing area for high school and college student competititons around the world:
http://www.thetech.org/exhibits_events/online/robotics/activities/index.html

The 2002 Tech Challenge
April 10th, 2002
What is the Tech Torch?
One day, in the not too distant future, we believe that the Olympics will come to Silicon Valley. Imagine the day when the torch arrives in the stadium. The final runner carries the torch high and places it on a pedestal. A robot emerges from the sidelines and, to the sound of 100,000 cheering spectators, lifts the torch. The robot carries the torch for the final few yards and sets it down to light the flame, which will burn throughout the games. We want you to invent something to carry the Tech Torch, our non-flammable version of the future.

The Challenge
Design, build and operate a device that will pick up, move and set down a make-believe torch. The torch has to be moved from one pedestal to another one 11 feet away. For success, your invention will place the torch firmly in the second pedestal within 3 minutes.

Event and Awards Ceremony

Where: Civic Auditorium (downtown San Jose, across from the Martin Luther King Library), 145 West San Carlos Street, San Jose, CA.

When: Wednesday, April 10, 2002, 2:00-7:30 pm. Check-in from 2:00-4:15 pm. Teams will be timed as they demonstrate their Challenge solutions in front of judges and spectators. Awards ceremony scheduled to begin at 7:00 pm.

Food will be available for purchase from the snack bar at the Civic Auditorium.

Prizes:

Best Entry Grand Prize
(Grades 5-6, Grades 7-8, Grades 9-12)

Best Overall
(2nd, 3rd, 4th, 5th place runners-up to Best Entry Grand Prizes)

Design Methodology Review
(1st, 2nd, and 3rd prizes for each grade level)

Best Team Spirit
(Grades 5-6, Grades 7-8, Grades 9-12)

Overall Awards will be given for:

* Best Costume
* Best Poster
* Best Looking Device
* Most Spectacular Failure
* Most Autonomous Device
* Fastest Device
* Most Creative Design

*Each team member will receive a team photograph. Awards include U.S. Savings Bonds, an "insider" experience of Silicon Valley and more!

The Tech Challenge is made possible with major funding from the Intel Endowment
Questions?
Get answers at challenge@thetech.org

Inspiring Teachers Workshops 2002
Every 4th Saturday: January 26 to April 27, 2002

Sponsored by The Noyce Foundation

Because of overwhelming demand, we've added some more Inspiring Teachers Workshops! Teachers may sign up for ONLY ONE of these weekend workshops (either Saturday February 23rd, or March 23rd, or April 27th). The series of workshops (where teachers attend all four workshops) is sold-out.

Inspiring Teachers workshops are for Bay Area teachers who are interested in learning more about the Tech Museum's programs for students and teachers. This FREE 3 hour workshop will include a design challenge, a tour of the museum, and an introduction to fieldtrips and other programs for students and teachers.

These additional workshops are from 9:15 - 12:30 pm every 4th Saturday in the Noyce Center for Learning classrooms B and C, at The Tech Museum starting February 23, 2002.

You can register by sending a note to cfl@thetech.org with your choice of dates, your name, School District, School name, your home or school address, city, state, zip code, phone and email address.

Benefits

* 1 year free membership to The Tech
* 10% discount at The Tech store
* Discount on a Family Membership @ The Tech

Dates

Inspiring Teachers Workshops Schedule
February 23, 2002 Design Challenge and Exploration Gallery WOW weekend
March 23, 2002 Design Challenge and Life Tech Gallery WOW weekend
April 27, 2002Design Challenge and Communication Gallery WOW weekend

The Noyce Center for Learning: A Professional Home for Teachers at The Tech
In honor of the late Robert N. Noyce, co-founder of Intel, the Center for Learning (CFL) supports K-12 education with outstanding professional development opportunities. The Center encourages innovation and experimentation, bringing the unique resources of The Tech to the essential effort to improve teaching and learning in science and mathematics and to promote the effective use of technology.

Like the galleries in The Tech, the Center for Learning strives to engage participants in the process of innovation. To accomplish this, the CFL employs a design-based, problem-solving approach. Through the CFL, teachers can gain hands-on experiences with science and technology, explore methods to bring real-world design-based problems into their classrooms, and share experiences and collaborations with other teachers and industry experts. Using the design process as a method to teach both problem-solving skills as well as content, the CFL seeks to enhance the skills and knowledge of both teachers and students.

Programs currently being offered through the CFL:
Tech Topics
Tech Topics is an engaging online curriculum resource for students and teachers that encourages in-depth investigations of grades 4-8 science topics. Each Tech Topic begins by building a conceptual understanding of the topic-at-hand, and then allows for

exploration of appropriate websites, hands-on activities, and real world applications to deepen students' understanding. Each topic concludes with a project or design challenge. Tech Topics are both aligned with the CA State frameworks and correlated to the galleries and exhibits at The Tech Museum of Innovation. Tech Topics also incorporates other exciting Internet resources making it a valuable tool to help teachers organize and integrate technology into their classrooms.

InTECHgration
InTECHgration is a program to support and accompany the implementation of Tech Topics in classrooms. InTECHgration takes a combined multi-visit approach of both Tech staff visits to schools as well as teacher/student visits to the museum. All activities are centered on the Tech Topic being studied.

Summer Institutes for Teacher Development
The Center for Learning is building on the rich resources at The Tech and its past work with teachers to offer an exciting approach to improving the teaching and learning of science primarily for teachers of grades 4-8. The Summer Institutes help teachers learn to incorporate problem solving and design challenges into their science teaching.

Tech Times for Teachers
Tech Times for Teachers is the Center for Learning's quarterly newsletter. It details the current events and programs being offered for educators at The Tech and each issue features a design challenge that teachers can use in their classrooms.

Educators' Nights
These special evening events are organized to give educators an opportunity to preview the latest IMAX attractions, learn more about upcoming programs at the museum, and explore the galleries. Refreshments are served and RSVP is required to attend.

Inspiring Teachers Workshops
Inspiring Teachers introduces teachers to the resources at The Tech as well as the programs offered by the Center for Learning. From scheduling field trips to building lesson plans around classroom visits, Inspiring Teachers helps participants make the most of the rich resources The Tech provides. Workshops are typically held the first and third Saturdays of the month. They last from 8:45 a.m. to noon. Admission is free and participants are given a free one-year membership to The Tech, a 10% discount in the store, and continuing education credits…

What is a Design Challenge?
Ever wanted to build cool stuff and experience design first-hand?? Then this workshop is for you! Design challenges are a great way to teach science to all grade levels. They can be very simple (e.g. build the tallest tower using 20 straws and 2 inches of tape) or they can be complicated (e.g. design a solar powered car). During Inspiring Teachers Workshops, we will do a design challenge, discuss the principles of design, and how to teach using this pedagogy.

Children's Discovery Museum of San Jose
http://www.cdm.org

In spring 2000, Children's Discovery Museum of San Jose celebrated its tenth anniversary as the cornerstone facility for interactive learning for schools and families throughout the Bay Area. Over four million teachers, children and parents visited and experienced the wonder and adventure of hands-on learning during that ten-year period.

Our thirteen exhibit galleries and program spaces house over 150 interactive exhibits and programs and provide learning experiences in the arts, sciences and humanities for children of diverse backgrounds, learning styles and interests. These experiences build upon children's fundamental need to learn-by-doing, fully engaging their senses and challenging their minds.

CDM is also a source for innovative approaches to educational reform, and we hope to establish the Museum as a strong educational presence in the minds of teachers, local school districts and our visitors. CDM has developed a number of educational outreach programs, staff development opportunities, and special programs which we would like to make more widely visible in the educational community.

Children's Discovery Museum of San Jose supports the work of the classroom teacher through the following initiatives:

* Teacher Advisory Committee
* Teacher Advisory Committee Newsletter: "Tales, Trips, and Teacher Tips"
* Museum Exhibits, Your Curriculum, and the State Content Standards
* Field Trips
* Pre- and Post-Visit Activities
* Museum Programs in Your Classroom
* Family Science Nights at Your School

The current issue of our teacher newsletter, Tales, Trips & Teacher Tips, is now available online! (New issue posted 2/6/2002): **http://www.cdm.org/p/viewPage.asp?mlid=29**

BioSITE **http://www.cdm.org/p/ViewPage.asp?mlid=33**
That 4th and 5th grade students could engage in authentic scientific research was a revolutionary idea in 1993, but Children's Discovery Museum of San Jose garnered the support of the Howard Hughes Medical Institute and matching funds from Cisco Systems, Inc. to create BioSITE (Students Investigating Their Environment).
Through the BioSITE program, over 500 students in the San Jose Unified School District are involved in a comprehensive environmental program focused on the banks of the Guadalupe River, where students collect and test water samples, look for plant and animal species, and document their findings.

Inquiry-Based Science
The Museum's BioSITE program is based on the belief that through the process of scientific inquiry all children can successfully grow and learn to make sense of the world in which they live.

As students explore and observe their environment, their experiences are grounded in an authentic research and water quality monitoring project.

Every student, each session, participates in water quality testing at one of three study sites along the Guadalupe River. Data collected over the past seven years includes bimonthly readings for Dissolved Oxygen, pH, Temperature, Conductivity, Turbidity, Rate of Flow and River Height.

"I just want to share with everyone that I was a genius today!"
-15 year old BioSITE student

To give elementary school students the support they need in the field, students are divided into small groups, each working with a high school or college age facilitator.

The elementary students benefit from more individual instruction and attention while the older students build valuable teaching, mentoring and science skills.

Designed to build knowledge and process skills in science, BioSITE offers students the opportunity to engage in real world "action-science" research, vividly demonstrating the relevance of science to their lives.

"At BioSITE I have a lot of fun learning about things, but not in, like, a boring way, like sitting down listening to the teacher . . . It's better learning like that, by looking at it in front of you, seeing it, touching it, and hearing it."
-4th grade BioSITE student

Environmental Awareness
The unique partnership between Children's Discovery Museum, local schools, environmental educators and community groups is an exemplary model for informal educators, formal educators, and organizations working together to strengthen science education and community awareness.

Regarded as "a model program to be replicated" by the architects of River Alliance, a systemic reform initiative of the San Jose Unified School District, BioSITE partnered with River Alliance in 1997 and expanded the Museum's program from the original 140 participants to include 30 Pioneer High School students, 150 Muir Middle School students, and the 4th and 5th grades from three additional elementary schools.

Curriculum & Resources
In addition to water quality research and monitoring, students are engaged in field-based science activities throughout the school year. Students learn first hand about animal adaptations as they catch and observe macroinvertebrates. As they study fish habitats and life cycles, students incubate, hatch and release native steelhead trout. BioSITE bird lessons coincide with annual migrations along the river.

"The middle schoolers are not only learning science by getting their hands and feet wet; they are participating in real research for an environmental conservation project."
-Howard Hughes Medical Institute Bulletin

Recent highlights of the program include:

* High school students receive class credit for BioSITE through Pioneer's innovative service learning program.
* Middle school students participate in weekly BioSITE sessions designed to integrate environmental science activities with Muir's existing 6th grade science curriculum.
* With support from the City of San Jose's Watershed Grants Program, the Museum provides each student with a custom field journal focused on data collection, observations, resource materials and reflection.
* BioSITE's future includes a new on-line database which will provide worldwide access to water quality data collected each week by BioSITE students. Our hope is that this database will connect the work of BioSITE students with other students, educators, scientists and environmental organizations from the local to the international level.

"Best thing about this program is learning science in a fun way . . . in this program I actually learn in a way I like."
- High School BioSITE Student

Funders
* Howard Hughes Medical Institute's Precollege Initiative
* Lucent Technologies Foundation
* Cisco Systems, Inc.
* City of San Jose Watershed Grants Program
* Santa Clara County's Urban Non-Point Source Pollution Prevention Program
* Robert Brownlee Foundation
* Santa Clara Valley Water District Grant In Aid Program

Community Partners
* Adopt A Watershed Program
* California State Department of Forestry
* City of San Jose Environmental Services Department
* Kids in Creeks Program
* San Jose Unified School District
* Santa Clara Valley Audubon Society

* Santa Clara Valley Water District
* S.T.E.P. (Salmon and Trout Education Program)
* Youth Science Institute
* Santa Clara Valley Water District Grant In Aid Program

High school students, would you like to earn community service hours the fun way? Join BioSITE ACE!

Synopsys Silicon Valley Science and Technology Outreach Foundation
Mountain View
http://www.outreach-foundation.org

Core Competency: Support of increasing the number of Silicon Valley K-12 students who do science fair projects, through professional development support to teachers in Project-Based Learning (PBL) and public science project exhibitions. Has a special focus on under-served school districts (e.g., ESUHSD).

Collaborators/Partners: Synsopsys, Inc., East Side Union High School District, San Jose Unified School District (High Schools only), Santa Clara County elementary, middle and high schools (excluding ESUHSD and SJUSD), business and industry partners, and community volunteers for judging and feedback of student science projects.

The Synopsys Silicon Valley Science and Technology Outreach Foundation is a non-profit foundation that works to promote project-based learning among students and teachers in Silicon Valley and encourages participation in science fairs.

Founded in July 1999, the Synopsys Outreach Foundation offers a program of teacher grants and training, grants to schools for materials and equipment, administrative support, project supplies, and a series of incentives for teachers and students who are developing science projects for competition.

In its first year of operation, the Synopsys Outreach Foundation helped to create a 400% increase in participation by high school students in large science fairs. During its second year, the programs were expanded and some level of support was provided to over 14,000 high school and middle school teachers and students. Beginning in September 2001, the Synopsys Outreach Foundation's activities will expand to include elementary schools.

In the 2001-02 academic year, the Synopsys Outreach Foundation will again serve as the major sponsor of the Synopsys Science and Technology Championship, the regional fair for grades 6-12. The Synopsys Outreach Foundation will also present sciencepalooza!, and will sponsor a program of school-based fairs for middle and elementary school students called science-o-rama

sciencepalooza! is a science project display featuring projects developed by students from the East Side Union High School District (ESUHSD) and held at Eastridge Shopping Center. The third annual **sciencepalooza!** was held March 2, 2002.

On March 3, 2001, over 700 students participated at the second annual **sciencepalooza!** along with San Jose Mayor Ron Gonzales, former Mayor Susan Hammer, and the CEOs of Synopsys, Inc. and Kinetics, Inc.

The Synopsys Silicon Valley Science and Technology Outreach provides support for sciencepalooza! by giving grants to teachers and to schools for supplies, materials and equipment. We offer training for teachers as well as on-site consultation and trouble-

shooting. We also provide project poster boards, ribbons and certificates, and a series of incentives for teachers and students

Bay Area Science Alliance (BASA)
http://www.basa.info (site still under construction)

WestEd: Eisenhower Regional Consortium for Mathematics and Science Education

The **Bay Area Science Alliance (BASA)** is a non-profit partnership of education and business leaders committed to fostering science education and literacy throughout the Bay Area. We provide information, training, and access to resources for teachers, parents, providers and the general public; encouraging participation in fun and educational activities related to the environment and science. BASA members collaborate to enhance science understanding and K-12 educational practices, in both formal and informal science instructional experiences.

The following are from notes from the initial BASA meeting (11/30/01); note that the Mission statement and activities of BASA are still in-process (not for publication):

Mission Statement would include:

Vision - what would result if BASA lived up to its highest promise?
Audience - teachers, providers, general public, parents.
Information dissemination to teachers, general public, parents.
Information exchange and collaboration/cooperation among providers.
Enhance skills and abilities of providers.
Combines what happens in schools, homes, science places.
The one stop shop, first place to go for Bay Area science education.
Serve in an inspirational leadership/change role.

What can BASA do?

1) **Dissemination and collaboration through a website, http://www.basa.info** (DRAFT website that has already been set up to illustrate some possible website functions). Website can include tools such as searchable databases and calendars. Different views for teachers and for the public. Would include mission statement (about BASA link), other features such as job openings, intern opportunities, grant opportunities, want ads (e.g., teachers to pilot curricula, websites, etc.). Bookmark or business card with the BASA website.

2) N**etworking through face-to-face meetings of providers**. This was the basis for the pre-SEABA Fifth Thursday Club. Quarterly meetings at different Bay Area locations would include a presentation/discussion on a topic of high interest, sufficient time for informal networking, and behind the scenes tour of the location.

3) **Professional development** - provide PD for providers on high interest topics (e.g., issues that we face in providing professional development for teachers and trying to improve school science education). Identify areas of duplication in the PD that we provide as well as gaps in the PD that is needed by/available to teachers. Coordinate to avoid unproductive duplication and to fill gaps.

4) **Professional development** - sponsor regional mini-conference as is done by Southern California Science Supervisors and by the Sacramento area science educator group. These have been organized around topics such as standards and assessment.

5) **Dissemination** - help identify Key Leaders and Points of Contact in Bay Area counties for CABAP ("California Building a Presence" in science).

6) **Advocacy** - help make the case for content rich curriculum (research, reports, slogan)

7) **Networking** - listserv for Bay Area science educators

8) **Encourage/find funding sources for collaboratives**; include districts in partnerships

9) **Funding** - develop and implement a funding plan for BASA that does not conflict with members.

BASA members include:

Alameda County Office of Education
Antioch Unified School District
Aquatic Habitat Institute
Aquatic Outreach Institute
Astronomical Society of the Pacific
Bay Area CREEC
Bay Model Visitor Center
California Academy of Sciences
California Department of Education
California State University, Hayward
Center for Ecoliteracy
Chabot Space and Science Center
Children's Discovery Museum
City College of San Francisco

Community Resources for Science
Contra Costa County Office of Education
Coyote Point Museum
DesignWorlds for Learning, Inc
Discovery Center of Sonoma County
Don Edwards San Francisco Bay National Wildlife Refuge
East Bay Regional Park District
East Side Union High School District
Environmental Education Council of Marin
Environmental Protection Agency
Environmental Volunteers
Exploratorium
Foothill College
Funders' Forum on Environmental Education
Golden Gate National Parks
Hall of Health
Headlands Institute
IISME
K-12 Alliance
Lawrence Berkeley Laboratory
Lawrence Hall of Science
Lawrence Livermore National Laboratory
Lindsay Wildlife Museum
Linking San Francisco
LO*OP Center, Inc.
Marin County Office of Education
Marine Mammal Center
Mission College
Napa County Office of Education
NASA Ames Research Center
National Health Museum
Natural Step
Oakland Museum of California
Oakland Unified School District
Oakland Zoo
Partners in School Innovation
Randall Museum
Resource Area For Teachers (RAFT)
Richardson Bay Wildlife Sanctuary and Whittell Education Center
Roots & Shoots
San Francisco Bay National Wildlife Refuge
San Francisco Mathematics Collaborative
San Francisco Recycling Program
San Francisco State University
San Francisco Unified School Dist.
San Francisco Zoological Society

San Joaquin County Office of Educ.
San Jose State University
San Mateo County Office of Educ.
Sandia National Laboratories
Santa Clara County Office of Education
Science Interchange
Science & Technology Department
SETI Institute
Shorebird Nature Center
Solano County Office of Education
Sonoma State University
Stanford Linear Accelerator Center
Stanford University
Stanislaus County Office of Education
The Exploratorium
The Tech Museum of Innovation
TOPS
U.S. Geological Survey
UC Museum of Paleontology
University of California, Berkeley
University of California, San Francisco
Walter S. Johnson Foundation
West Contra Costa Unified School District
WestEd
WildCARE - Terwilliger Nature Center

LITES
(Leadership Institute for Teaching Elementary Science)

Worm Digest's Online Articles
http://www.wormdigest.org/articles/index.cgi?read=10

"Elementary Students In Oakland Wiggle Through Science With Worms"
(from Issue 10)

Written By: Cindy Nelson, LITES Coordinator of Special Curriculum
Posted On: Monday, 16 November 1998, at 8:22 p.m.

Classroom worm boxes have found their way into a major science education project this past year in a large, northern California school district. The five-year, $3.1 million, National Science Foundation-funded LITES program (Leadership Institute for Teaching Elementary Science), administered by Mills College in Oakland, California, is focused on improving the teaching of science in Oakland's elementary schools. A small part of the science education effort includes worm boxes and school gardens. Nearly 200 classroom worm boxes have been delivered free to interested elementary teachers in Oakland, and hundreds of worm lessons have been presented to K-6 teachers and their students.

The program has been very successful in its first year and the response to worms has been very positive. Usually the kids' enthusiasm brings in those teachers that aren't so sure at first. We've had worms die and worm boxes neglected, and even a janitor who threw a worm box in the trash thinking it was a health hazard, but overall the kids and teachers have loved the worms. I'm most proud that we are now beginning to have older kids teaching younger kids about worms.

The science education focus is extensive. Elementary teachers that join LITES participate in two years of coursework, which includes biology, physics, chemistry, mathematics, earth science, technology, pedagogy, managing change, and ecology. Courses are taught at Mills College, at informal science centers (such as University of California at Berkeley's Botanical Garden and San Francisco's Insect Zoo), and at regional parks.

Seventy teachers from Oakland's year-round schools began the program in August of 1994. This August, a new group of seventy teachers will join the program on a parallel track of courses. By 1998, one-fifth of Oakland's elementary teachers from sixty schools will have completed the program and they, in turn, will have created a plan for more science instruction at their schools. The worm boxes are not limited to the LITES participants; any elementary teacher in the District is eligible to receive one for their classroom. Thus, worm boxes are one way that all Oakland teachers can participate in LITES.

"A unique feature of LITES is the follow-up support that is provided in the classrooms," says Caroline Yee, Teacher Liaison for LITES. Yee, along with two other experienced Oakland teachers have been hired to teach the pedagogy course and, additionally, to visit LITES participants in their classrooms, assist them in teaching a science lesson, help with teacher in-services on science, facilitate school-site plans for science, and locate science instructional materials.

The worm box portion of LITES fits into both instruction and follow-up support. One day of the pedagogy course is "worm day" and a variety of guided-discovery lessons and observations are presented, along with a slide show seminar on worms and worm composting. The biology course incorporates a lesson on vermicompost, studying biotic and abiotic components of an underground ecosystem. The worm boxes are being used as the first year model for integrated teaching of science. Many of the Oakland teachers are developing and using a variety of worm lessons that include the teaching of ecology, social sciences, earth science, physical science, math, language arts, music, and art.

Any elementary teacher in Oakland can receive a free classroom worm box, 500 red wigglers, and Mary Appelhof's book, Worms Eat Our Garbage: Classroom Activities For A Better Environment. The bottom line is to introduce city kids to the idea that food waste can be recycled by feeding it to worms, and the resulting worm poop can be collected for use on growing plants. A worm box in the classroom is just the beginning. Ultimately, we hope the connections will be made, through school gardens, that worms are essential for healthy soil and healthy food. As many of us know, worm manure is nature's best fertilizer. We want kids to begin to learn what food is, where it comes from, and what is required to produce it. Worms in the classroom can be a catalyst for this essential discovery.

LITES contracted with the East Bay Conservation Corps for the initial 210 wooden worm boxes. They were built by Oakland middle school students last summer as part of a service learning curriculum through Project YES (Youth Engaged In Service). The kids learned a little about construction, about working together in a cooperative way, and about worm composting. Some of these kids later went on to make worm composting presentations to students in nearby elementary school classrooms.

As overseer of the worm box and garden piece, I have visited many Oakland classrooms this past year, setting up live worm observations, having kids measure and compare gummy worms, showing slides, and helping set up worm boxes. A "Worm Wednesday" was sponsored by LITES which allowed teachers the opportunity to share their worm lessons and to learn new ones. Mary Appelhof made a special appearance at Mills College in May, and thrilled teachers and students with her presence and stories. She graciously posed for an unending stream of individual pictures with participants at the reception, and LITES staff later mailed out these pictures as souvenirs.

One example of extension work is a small vermicomposting project to recycle some of the cafeteria waste at one of the year-round schools. (Several of the year-round schools have student bodies of 1,400, so full-scale recycling of food waste may be a few years

away.) Hopefully, through LITES and other collaborating organizations, the idea of worm composting will become commonplace in Oakland.

In the Oakland elementary schools, worms have become a powerful tool for teaching science. "Kids love worms," says Krishen Laetsch, Program Director for LITES. "There's no doubt about that. They may be squeamish at first, but I've never been in a class that didn't find them interesting and fun, and it sure provides kids with a lot to interact about."

LITES is being closely observed across the country as one of several national efforts to improve science education and to create systemic reform in the schools. Red wigglers are winning the hearts and imaginations of Oakland kids and teaching them how they can make a difference in their environment. It's very satisfying for me to be at some local event with a worm box display and to have kids come up to the table and tell me they already know all about worms 'cuz they have one in their classroom.

For more information on worms in Oakland, contact Cindy Nelson at LITES, Mills College, 5000 MacArthur Boulevard, Oakland, CA, 94613, Phone: (510) 430-3169, FAX: 510-430-3379, or e-mail: cindyn@mills.edu.

The following report highlights the success of the LITES program as a predecessor to the SKILL Project (a collaboration of U.C. Berkeley, Lawrence aHall of Science and the Okland Unifited School District). This report highlights LITES teachers as having played a key coordinating teacher role in the Oakland schools for science learning.
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From California Postsecondary Education Commission: Tenth Year Competition: Math and Science Projects

Project Abstract: University of California at Berkeley, Lawrence Hall of Science and Oakland Unified School District:
"Science Knowledge through Inquiry and Language Literacy (SKILL)"
Project #1012
http://www.cpec.ca.gov/eisenhower/mathsci/1012.asp

Science

Goals and objectives of the project

This project is designed to build on the progress made by Oakland Unified School District's (OUSD) Systemic Change Initiative by working with a core group of K-5 leader teachers, connecting their efforts to language literacy work and supporting these teachers in furthering science reform with their OUSD colleagues. The strategic goals are:

Goal 1: To move the core of leader teachers in the OUSD's systemic reform effort from mechanical implementations of curricula and kits to inquiry-based teaching of their curriculum;

Goal 2: To connect the teaching of science to language literacy instruction in order to provide mutual reinforcement in both areas; and

Goal 3: To initiate inquiry-based implementation of OUSD's new Science Standards for K-5.

Description of teachers and students served by project

Of the 52,239 students in the OUSD, 53 percent are African-American, 18 percent Hispanic, 20 percent Asian/Pacific Islanders, and 7 percent White non-Hispanic. Twenty-six percent are Limited English Proficient and 60 percent qualify for free/reduced lunch while 48 percent receive Aid to Families with Dependent Children rising to over 90 percent in some schools. Sixty-six percent of the teaching staff are ethnic minorities. Although the program is designed to have wide ranging impact on OUSD's science reform efforts, it targets a portion of the 1,200 K-5 teachers in the district. Specifically, the LITES systemic initiative has worked with school-designated classroom teachers who have played leadership roles as "Coordinator Teachers." OUSD is putting in place a "Site Literacy Coach" for each of its 59 elementary schools. These two groups constitute the core targets for the program, since they will be able to spread the lessons learned as part of the SKILL program to all Oakland K-5 teachers.

Number of schools involved in project: 57
Number of districts involved in the project: 1
Number of institutions of higher education: 1
Projected Number of K-12 teachers served: 600

Chabot Space & Science Center
Oakland, CA
http://www.chabotspace.org

Youth Programs

Birthday Parties at the Science Center
Launch your birthday into orbit with a fun-filled party at Chabot Space & Science Center!

School Group Field Trips
School groups can choose classes in astronomy, life sciences, physical sciences, computer technology, or environmental education. All school group visits include a show in our state-of-the-art Ask Jeeves Planetarium and time to explore CSSC's permanent exhibits.

FIRST: Female Involvement in Real Science & Technology
The FIRST program provides an informal setting for girls to engage in hands-on science at elementary and middle schools in the Oakland Unified School District. With a grant from the National Science Foundation, Chabot Space & Science Center supported FIRST science clubs in seven Oakland schools from 1996 to 2000. FIRST continues to be supported with NSF funds at the California School for the Blind in Fremont, California.

Galaxy Explorers
Galaxy Explorers is an afterschool, weekend, and summer program for high school students who represent the new Chabot Space & Science Center on-site and throughout the Oakland area. As participants in this 7-days-a-week immersion experience, these young adults receive training and paid internships to explain concepts in astronomy, space and science to visitors of the Science Center. They perform outreach activities in neighborhood schools and community centers to involve all members of the Oakland community in the opportunities available at one of the most innovative science centers in the United States. The program is designed to engage individual students throughout their high school years in long-term relationships with the Science Center and community partners. As part of their commitment, participating students must complete on-going workshops in youth leadership development.

At all stages, participants in the program benefit from exposure to technology, from sharing and implementing their own ideas and accepting responsibility, and from the encouragement of program staff and volunteers to take on leadership roles in science, math and technology activities.

Summer Camps — Explore your place in the Universe!
Explore space and earth science, astronomy, technology, and robotics for an unforgettable summer adventure at the new Science Center.

Techbridge: Encouraging Girls in Science & Technology
What do girls imagine when they think of computers and technology? With a grant from the National Science Foundation, Chabot Space & Science Center is developing Techbridge, a three-year model program that engages teachers, counselors, families, role models and peers in keeping girls involved and motivated in technology.

Volunteer Opportunities
Exciting volunteer opportunities are available for teens ages 13 and above. If you enjoy science, astronomy, space, or just sharing information with people, then volunteering at CSSC might be for you.

Teacher Programs
Chabot Space & Science Center offers year-round educational opportunities for teachers and exciting programs for your students:

K-12 field trips: science classes in our state-of-the-art astronomy, life science, physical science, and computer labs and classrooms, and environmental education hikes through the surrounding redwood forest, plus hands-on exhibits, our state-of-the-art Ask Jeeves Planetarium, and more.

Teacher Workshops
Summer institutes for teachers focus on new content, methods and pedagogy in science education, with follow-up training throughout the academic year.

Right from the Start - Teacher Training for Middle School Science Teachers:
Sponsored by the Pacific Bell Bay Area Teacher Development Program and the San Francisco Foundation, this is an intensive teacher-training program for Oakland public middle school science teachers. Through the **Right from the Start** program, we are helping Oakland teachers develop course guides for all the sciences taught in the middle schools. In addition, teachers in the program can bring their classes to the Science Center for free, are offered in-class coaching, and are assisted in gaining the resources they need in their work. Visit the program's web site: http://tlc.ousd.k12.ca.us/~acody/focus.html or call (510) 336-7317 for more information or to join the program.

Outreach programs, including classes, the STARLAB Portable Planetarium, and CSSC's traveling science fair, Chabot-to-Go

Teacher Research Center, a forum for discussion and collaborative learning of the best practices of science education

The Museum Explainer Component
Through the Museum Explainer component, young people are trained and paid to explain the exhibits at the new science center. With an anticipated 250,000 annual visitors and galleries of technologically-advanced exhibits, plus daily science demonstrations, lectures, and classes, the new science center will present opportunities for participants to work during afterschool, weekend, and summer hours. They will explain and demonstrate science concepts and experiments to a diverse audience, many of whom will be children.

FIRST Classrooms
Benefits extend beyond FIRST's after-school clubs. FIRST teachers receive resources that enrich science and technology lessons in their classrooms. FIRST funds have made it possible for some students to use a microscope for the first time. Science books have been added to classroom libraries, enhancing curriculum and encouraging students' curiosity. At Sequoia Elementary school, the field guides purchased with FIRST funds became favorite reading material during free time.

These additions in FIRST classrooms are helping to change the way that students think of science and scientists. When asked to draw a picture of a scientist, most children and adults draw a picture of a man working in a laboratory. Students in FIRST also envisioned females in science careers. Take a look at one student's drawing. We are excited to learn to that FIRST parents and siblings also envision girls in FIRST as future scientists.

Teacher Workshops

Teacher Research Center
Outreach Programs

Chabot-To-Go: CSSC’s traveling science fair!

Chabot Space & Science Center's traveling science fair will come to your school or organization evenings and weekends. Chabot-to-Go features at least four tables of hands-on space and science activities for all ages. Perfect for a PTA event or family nights!

Content Packages

* Astronomy: Activities based upon stars, galaxies, constellations, the solar system, planets, moons, asteroids, and comets.
* Space and Astronaut Training: Activities based upon human exploration, rockets, space shuttles, astronaut apparatus training.

* CSSC Sampler: Activities selected from various sciences and from the Astronomy & Space and Astronaut Training content packages.

Starlab -- the Portable Planetarium
Enjoy the night sky in our portable planetarium. Average show length 20 minutes. Starlab dimensions: 22' x 20' x 11'. The Starlab requires two electrical outlets, and can only be used indoors. Any room used for the Starlab should have carpeted or tiled floors. Starlab accommodates approximately 20 persons.

Star Station One
Star Station One is Chabot Space & Science Center's interactive demonstration program about the International Space Station. CSSC was selected as one of only 62 science centers and museums around the U.S. to participate in this national education program. The program, sponsored by the Boeing Company and developed by the Bishop Museum, Space Center Houston, and NASA, is designed to build public awareness of the developing International Space Station (ISS). The exciting and informative program will feature:

* Demonstrations and activities about the ISS
* Annual teacher trainings on the ISS
* Educational materials for teachers and students, available on CSSC's Web site
* Two realistic scale models (1/144 scale and 1/50 scale) of the completed International Space Station

Program Description

As a Star Station One site, CSSC will offer live demonstrations on the exhibit floor about the International Space Station. The fun, audience-interactive demonstrations, approximately 15-20 minutes in length, will be performed by trained CSSC staff and volunteers. Demonstration on topics such as "Living in Space" will focus on how astronauts living on the ISS will adapt to the rigorous microgravity environment, from exercising and eating to going to the bathroom in space!

The Star Station One demonstrations will be updated every two months, addressing a new topic about the International Space Station.

Teacher education workshops will be offered each summer, updated to include the latest information on ISS construction and science research. The workshops will include examples of hands-on activities for students, background information materials, and suggestions for integrating the ISS in an interdisciplinary manner.

Student activities about the International Space Station will be incorporated into relevant CSSC school programs and summer camps. Students will be able to conduct hands-on experiments modeling the research on the ISS, learn the technology behind the in-orbit construction of the ISS, and hear the latest information about the ISS as these programs are updated to include the most current information.

About the International Space Station

The ISS is the largest international peacetime project in history, with 16 countries currently contributing resources and hardware to the endeavor. To be completed in 2004, the ISS will be a state-of-the-art, multipurpose laboratory in Earth orbit that will provide a facility for discoveries in fields such as science, technology, and medicine. NASA expects it will take some 45 launches and hundreds of pieces to assemble the ISS over a five-year period. When completed, the ISS will be larger than a football field, and the second brightest object in the night sky!

With the resources available at the new facility, all teacher programs will be expanded in order to serve up to 2,000 teachers annually, who in turn will reach 60,000 students each year. CSSC's programs will continue to focus on astronomy and space sciences, and greater emphasis will be placed on technology training, environmental education, and preservice programs for the next generation of science teachers. All teachers will benefit from access to CSSC's facilities, equipment, and labs and will remain connected to CSSC, its resources, and its partners through the Virtual Science CenterSM

Smithsonian Affiliate—Chabot Space and Science Center

This public observatory expanded to a new facility and celebrated its grand re-opening in August 2000. This new science education complex contains a state-of-the-art Zeiss planetarium, an OMNI IMAX-style theater, the only Challenger Center in the San

Francisco Bay Area, lab space, gallery space, historic telescopes, an outdoor astronomy viewing platform, and one of the largest publicly accessible telescopes in the country.

APPENDIX D: Additional Web and Internet Resources for Museums and Collaborative Science Education Programs

ActiveWorlds A 3D set of graphical, online "Virtual Worlds" environments for multi-user games, learning, meetings, and exploration. http://www.activeworlds.com

American Association of Museums http://www.aam.org

Association for Supervision & Curriculum Development (ASCD)
http://www.ascd.orgThis is the best resource for interdisciplinary, design-centered learning. It includes exemplary projects, curriculum integration activities, and resources. Design projects range from kids collaboratively designing "never before seen" cities or civilizations of the future to designing a wide variety of products and solutions to environmental or social problems.

Association of Science-Technology Centers http://www.astc.org

Association of Youth Museums http://www.aym.org

Bruckman, Amy. **MOOSE Crossing (a MOO for kids)**
http://www.cc.gatech.edu/fac/asb/moose-crossing/

California Regional Environmental Education Community Network (CREEC)
Online statewide resource directory of environmental education resources, curricular activities, and events (both for students, teachers and the public); searchable by region or topic area. http://www.creec.org

Center for Innovative Learning Technologies http://www.cilt.org
This is an NSF-funded national virtual collaboration, led by staff of SRI International, University of California, Berkeley, The Concord Consortium, and Vanderbilt University.

CHILDMUS CHILDMUS@listserv.rice.edu a listserv interest group centered around youth museums.

Converge Magazine http://www.convergemag.com/magazine/
This is an excellent resource magazine on technology, the Internet, distance learning, and other related issues for schools and communities integrating technology with curricula and professional development.

DesignWorlds for Learning, Inc. http://www.designworlds.com This is a Web site of curriculum resources, exemplary projects, people and organizations that are involved in collaborative, Web-based virtual learning communities. DesignWorlds' home page points to a variety of resources, people, tools, and exemplary projects in which students, teachers, parents, and professionals are collaborative, creative partners in creating and linking learning resources including K-12 schools, museums, higher education

institutions, government and private R&D organizations, and other partners. A special focus of these projects is the collaborative design and production of multimedia-rich Web learning resources by various DesignWorlds virtual communities.

Exploratorium Institute for Inquiry http://www.exploratorium.edu/IFI/ numerous resources, especially for K-6 teachers, on the practices of inquiry-based science learning in the classroom. Live@Exloratorium is a series of live and archived webcasts, usually designed around events such as the last solar eclipse of the 20th century http://www.exploratorium.edu/eclipse/, live interaction with the Hubble Space Telescope http://www.exploratorium.edu/hubble/, and most recently, live transmissions from Antarctica.

"**ExploreScience**" http://www.explorescience.com and "**ExploreMath**" http://www.exploremath.com**.** Both produced by ExploreLearning.com, these are two excellent interactive science and math learning resources on the Web.

The George Lucas Educational Foundation (GLEF) San Rafael: CA. http://www.glef.org. One of the best online resources for integration of technology into K-12, informal and global learning, school reform, and teacher preparation/continuing professional development.

Global Museum http://www.globalmuseum.org/

ISEN-ASTC-L a listserv of science museum and informal science educators, sponsored by the Association of Science and Technology Centers (ASTC). For more information, see http://www.astc.org

JASON Project The JASON Foundation for Education is dedicated to inspiring in students a lifelong passion to pursue learning in science, math and technology through exploration and discovery. Each year, the JASON Project produces live broadcasts and related curriculum from remote locations through its expeditions, as well as providing online science academy courses. http://www.jason.org

"Kids Who Know and Do" Annual Project-Based Learning Conference
http://www.kwkd.net
A major annual conference, originated by the Autodesk Foundation and now sponsored by Co-nect.net, this is a rapidly growing K-12 teacher, school-to-careers and professional development community of practitioners of Project-Based Learning (PBL).

MERLOT http://www.merlot.org A major collaboration of faculty from colleges and universities all over the U.S. in contributing interactive, Java and web-based "learning objects" and learning resources, for use by college students and instructors, as well as K-12 teachers.

Museum Computer Network http://www.mcn.edu/sitesonline.htm Links to over 1,000 museums worldwide.

NASA Ames Research Center http://www.quest.arc.nasa.gov Online science and technology resources.

New Media Centers http://www.newmediacenters.org Collaboration between colleges and universities and business, industry, museums, government and other non-profit organizations around effective development and applications of new digital media to education and lifelong learning.

Passport to Knowledge http://www.passporttoknowledge.com This is an ongoing collaboration of electronic field trips, using live and online events, that give students a real understanding of scientific exploration and the practice of scientists. The curriculum units, videos, web and net interactions, and live broadcasts have been supported by NASA, NSF, and the National Oceanographic and Atmospheric Administration (NOAA).

PBS Online Learning Resources http://www.pbs.org

ScienceAdventures http://www.scienceadventures.org Produced by WestEd's Eisenhower Regional Consortium for Mathematics and Science Education, this is a web guide to informal science centers, including museums and science centers, nature centers, parks and gardens, zoos, aquariums, and aviaries, and planetariums and observatories all over the U.S. In a sense, ScienceAdventures is a national extension of the former (regional) WestEd-sponsored Science Education Academy of the Bay Area (SEABA).

Science Friday (with Ira Flato) http://www.sciencefriday.com Weekly NPR radio talk show around topics, current events and people in science, mathematics, technology, engineering, etc.

Science Learning Network http://www.sln.org A major national (now international) online collaborative science museum and school network, funded by the National Science Foundation and Unisys Corporation. Six founding museums each partnered with one school, and the network has now expanded internationally. The original six founders and school partners were: Exloratorium (San Francisco) and Ross Elementary School; Museum of Science (Boston) and Hosner School; Franklin Institute (Philadelphia) and Levey School; Miami Museum of Science (Miami, FL) and Avocado Elementary School; Oregon Museum of Science & Industry (Portland) and Buckman School; and Science Museum of Minnesota (Minneapolis) and Museum Magnet School.

ScienceMaster Learning Science through Technology Monthly online newsletter newsletter@sciencemaster.com and web site of resources for school and informal learning http://www.sciencemaster.com

TECHSCAPE http://www.techscape.org (WestEd) Online resource of design-based learning challenges and resources tying together science, simulation, and invention.

TryScience http://www.tryscience.org A global network, linking resources of over 400 science museums around the world, with interactive activities, explorations and science learning resources. This project is funded by IBM, in partnership with the Association of Science-Technology Centers and the New York Hall of Science.

Voyages Through Time http://www.seti.org/education/An integrated high school science curriculum, collaboratively developed by the SETI Institute, NASA Ames Research Center, San Francisco State University and the California Academy of Sciences. Funded by NSF, this curriculum focus on evolutionary change as a powerful recurring theme for studying multiple areas of science. This multimedia and web-enriched curriculum is now being beta-tested in numerous high schools in the San Francisco Bay Area and across the U.S.

WestEd (Regional Technology in Education Consortium) & DesignWorlds for Learning, Inc. Exemplary Project-Based Learning (PBL) Project Resources http://www.techscape.org/mp/welcome.html

APPENDIX E: Exemplary and Emerging Technologies and Applications Relevant to a Bay Area SMETE Collaboratory

ACME Virtual Training Network (VTN)

http://www.convergemag.com/magazine/story.phtml?id=2530000000002296
http://www.convergemag.com/Publications/CNVGSept98/warnerbros/warnerbros.shtm

The ACME Virtual Training Network (VTN) is an intensive, interactive, distance-learning initiative that focuses and builds on the most important foundation skill in animation: the ability to draw. Using live interactive two-way video/audio conferencing systems, ACME VTN gives self-selecting students and teachers at qualified remote locations a hands-on opportunity to learn the art of animation from the industry' s top professionals and to improve their ability to meet the animation industry's highly competitive, entry-level Students from multiple high school and college sites participate in weekly live broadcasts with presentations and feedback by professional Hollywood studio animators and story development artists. ACME VTN was originally piloted as a nine-month virtual training program for high school and college students who possessed fundamental drawing skills and were eager to test the waters of animation. This project was designed to reduce the need for remedial-level and/or basic animation training at job sites by helping emerging and established preparatory programs to meet industry standards in a more efficient way—regardless of these programs' demographic profiles or geographic locations.

The classrooms of teachers and students (referred to as sites) that have participated in the three-year pilot are from four academic institutions in California: San Jose State University (Art & Design), CSU Northridge, CSU Fullerton, and Rowland High School/La Puente Valley ROP; and three in Birmingham, Alabama: Phillips High School, Jefferson State Junior College, and Lawson State Community College & Arts Academy.

Annotated Digital Video (on the web)

For example: http://apple.com/education/dv/gallery/ and http://apple.com/education/dv/tips/ The growth of low-cost digital video camcorders, together with easy-to-use, non-linear video editing software (such as Apple's iMovie 2 and Final Cut Pro), has made video-making a much more widely used (and sharable) process inside and outside of the classroom. Video clips can now be attached as email messages, integrated fairly easily into web sites, and actually annotated with voice-over or subtitle text as a student learning or teacher professional development resource.

Apple Learning Interchange (ALI) and California Learning Interchange

http://ali.apple.comThis is a growing web resource created largely for and by teachers. Based originally on the same concept and database-driven web technologies as the Educational Object Economy (EOE), exemplary curriculum lessons or "units of practice" are submitted by teachers, peer-reviewed and rated by other teachers, and links are made to numerous educational standards—from national curriculum standards to local or state standards and curriculum frameworks.

Dave Master, Workforce LA and LaBounty Chair of Education & Integrative Studies, Cal Poly Pomona dave_master_edu@yahoo.com

The Educational Object Economy Foundation (EOE) http://www.eoe.org The Educational Object Economy (EOE was initially designed as an advanced research project at Apple Computer (originally funded by the National Science Foundation), to develop a new model of building virtual communities. The main premise of the EOE is that members can learn about a new technology such as Java through contributing small application examples ("applets") and sharing with their experiences with other members. This practice has included contributing articles or short "think pieces," member-written reviews, and active social "brokering" between developers and educators to suggest improvements or revisions of contributed applications designed to ensure the highest quality application for education and informal learning.
EOE members have contributed over 2,000 Java applets and other resources for use in education to a specially designed EOE Web site. This site has been designed around easy-to-use database technology (FileMaker Pro 4.x) that can be easily exported to either Macintosh or Windows servers. Through the creation of a "starter kit" of freely-downloadable files and templates, known as the Generic Object Economy (GOE), this architecture has made it possible for other groups to set up their own virtual communities and Web site in a matter of hours.

ESCOT: Educational Software Components of Tomorrow
http://www.escot.org and http://www.mathforum.org/escot/ (archive of electronic "Problems of the Week") Like the EOE, ESCOT is based on the promise of supporting, leveraging and integrating the intellectual assets of a virtual community, based on shared interest and practices around promoting Web-based component software technologies. This community involves active collaboration of multiple R&D organizations, commercial software and curriculum companies, and teachers—and ultimately, students themselves—in the collaborative design of both Java/Web-based interactive software technologies and curriculum activities that embody the effective use of these technologies. One key to the successful collaboration between these partners was a shared goal of co-designing and co-producing a full year of bi-weekly e-POWs (electronic Problems-of-the-Week), published on MathForum.org for use by middle school teachers and students.

Global Schoolnet Foundation http://www.gsn.org/gsn Global Schoolnet (GSN) is one of the oldest non-profit groups supporting teachers and students to do Internet-based education projects. Co-founded by Al Rogers and Yvonne Andres, GSN has created an important national and international leadership community of teachers and educators who have pioneered many new Internet-based technologies in education as they have first emerged from research (e.g., CU-SeeMe videoconferencing). They also have developed very important rubrics for evaluating student Web-based projects, such as those submitted for their CyberFaire contests.

Science Interchange & Earth News Radio http://www.earthnewsradio.org or email Jerry Kay at earth@enn.com Recent research indicates that teens are not sufficiently prepared in the area of writing when entering college. In the next century, the

fundamental skills of communication (both written and verbal) will be considered as essential to all future employees, as well as the ability to learn and use diverse technologies for creation and effective communication of knowledge.

Bay Area radio and media personality/educator, Jerry Kay, has created Earth News Radio and the Science Interchange Teen Environmental Media Network to address these ideas by offering real work opportunities for high school students to acquire these skills. Kay feels that student creation and distribution of media in digital format provides a unique opportunity to integrate various media (such as text, audio and video), facilitates the public's involvement in the communication process, and offers a tremendous opportunity to engage teens. He is actively seeking Bay Area high school students interested in journalism, Web radio, radio and video, who will work with (and be mentored by) some the nation's best environmental journalists.

Students involved in the Network write stories, interview experts, produce radio programs and multimedia content for web sites. Stories appear on their web site http://www.earthnewsradio.org Also, the Environmental News Network has distributed student stories to CNN and National Geographic. Earth News radio programs are heard in the San Francisco Bay Area on KQED and KCBS, and they are heard nationally on CBS radio. This project could be hosted by multiple museums and informal science learning centers around the Bay Area.

Silicon Graphics Inc. (SGI) Virtual Science Theater
http://comjputerheadline.co.uk/AfterHours/Feature/feature_gsp.sp SGI has produced a number of state-of-the-art VST installations in museums, including the Hayden Planetarium at the Museum of Natural History (New York) and the Glasgow Science Centre. All these museum VST installations are based on totally immersive 3D-visualization environments, using 16 processor SGI Onyx2® InfiniteReality3™ systems, which drive six projector stereo display system onto a four meter radius, 160 degree cyclindrical Trimension screen. Content materail for these installations is sourced from **SGI's Virtual Science Network (VSN),** which links the worlds of science discovery and education of museums which have VST installations. http://www.sgi.com/realitycenter/

Streaming Media Webcasting and QuickTime Time TV for Learning:
http://ali.apple.com/events/aliqttv/
http://www.exploratorium.edu/eclipse/
http://www.exploratorium.edu/hubble/
http://video.csupomona.edu

TAPPED IN http://www.tappedin.org TAPPED IN is a Multi-User Virtual Environment (MUVE) focused around Teacher Professional Development (TPD). Developed by SRI International, it is one of the fastest-growing federally-funded R&D in developing effective virtual community support for alternative models of TPD. This environment has also been used for pre-service teachers, as well as students, for various online collaborations. As of June, 1999, TAPPED IN had grown to over 4,200 members,

including 1,400 new teachers from the Los Angeles County Office of Education who are being trained this summer.
(See more information in excerpt from one of TAPPED IN's published research papers (e.g., Schlager, et al., 1998 in Appendix III) or a good practitioner's article in *Edutopia* by Gray, 1999).

ThinkQuest: An international showcase of student collaborative creativity http://www.thinkquest.org ThinkQuest is a non-profit, annual international student competition in which teams of students, ages 12-19 (often from different schools or even different states/countries), collaboratively design Web and multimedia-based educational sites, products or projects. This competition has grown substantially since its inception, and there is a large pool of college scholarships and other awards now given to winners in various different categories. ThinkQuest focuses on helping students develop the following skills, all of which are directly relevant to using the Web and multimedia for authentic learning:

- collaboration (teams of 3-4 students, often from different schools or even different countries, and mentors/sponsors)
- creativity (end products are Web and multimedia-based products with educational value)
- effective communication through using digital media
- authentic audience for student work (with excellent scholarship/award opportunities)
- exposure to and feedback on student work from both industry and academic communities

Applications for student teams and sponsors/advisors are usually due in March, with projects due during the summer and awards presented in November. An informational resource CD-ROM (with samples of past student winning work) is also available from the ThinkQuest web site. A ThinkQuest Junior competition has being added for students from 4th-6th grades, as well as a special ThinkQuest for new teachers.

Using museums as public access and education centers for the ThinkQuest competition can help promote the education mission of museums, as well as increase museums' educational outreach programs to schools.

"A Video Exploration of Classroom Assessment" CD-ROM (IRL and Jason Marsh Multimedia) http://www.wested.org/cs/wew/view/rs/534 This CD-ROM is an excellent resource for workshops with teachers to help them understand four alternative assessment strategies used by a middle school mathmematics teacher her colleagues. It has an award-winning user interface, including video (QuickTime) clips that are complemented by complete text transcriptions of all the conversations and comments made. It also includes multiple perspective comments by teachers and students on the use of four major

WestEd: Exemplary Project-Based Learning Projects, Regional Technology in Education Consortium http://www.techscape.org/mp/welcome.html This web site, co-developed by a DesignWorlds for Learning team, is part of WestEd's Regional

Technology in Education Consortium (RTEC) project, funded by the U.S. Department of Education. This web site shows middle school teachers annotated examples of several exemplary, interdisciplinary “Project-Based Learning” (PBL) projects, including links to various national curriculum standards, alternative forms of assessment, and research and other resources on PBL.

About the Authors

Dr. Ted Kahn
DesignWorlds for Learning, Inc.

Dr. Ted M. Kahn is the co-founder and president of DesignWorlds for Learning, Inc. and a co-founding principal of CapitalWorks, LLC. Ted is internationally known as a pioneer and innovator in action-research projects and commercial products involving technology and learning in schools, homes, workplaces, and museums. He was recently profiled as a national innovator and leader in education and technology in *Converge* magazine for a career of over 30 years of work in education and non-profit institutions, high technology companies and research labs, including: The Lawrence Hall of Science in Berkeley, the Centre for Educational Technology (Israel), Xerox Palo Alto Research Center (PARC), Atari (Warner Communications), Picodyne Corporation, Digital F/X, and the Institute for Research on Learning (IRL). He has also consulted and developed products or projects for several companies and non-profit organizations, including Syntex Laboratories, Apple Computer, Microsoft, National Geographic Society, and PBS.

Ted has designed curricula and interdisciplinary learning projects for school and school-to-career programs; co-authored three books on recreational learning with computers; researched and developed alternative distance learning and computer-based training systems, and co-designed several award-winning commercial technology products and systems. He is a GLEF Fellow of The George Lucas Educational Foundation, a Senior Fellow with the EOE Foundation and was a visiting Senior Fellow at the UCLA Graduate School of Education & Information Studies. He has also served as a member of the Board for several non-profit organizations, including the Broad Alliance for Multimedia Technology & Applications (BAMTA, the Children's Discovery Museum of San Jose. and the Industry Education Council of California. He has also served as a consultant to many companies, universities, and government agencies, including Apple, the former U.S. Congress Office of Technology Assessment (OTA), the new Riverside School for the Arts (RSA), and the U.S. Agency for International Development. Dr. Kahn received his B.A. in computer science and his M.A. and Ph.D. in psychology, all from the University of California, Berkeley.

DesignWorlds for Learning http://www.designworlds.com is a company that helps facilitate building effective lifelong learning communities through designing and enabling creative virtual collaborations between schools, homes, workplaces, museums, and other learning environments. CapitalWorks, LLC, http://www.capworks.com is a company dedicated to optimizing human capital performance through enabling continuous, effective learning in business and industry.

Saul Rockman
ROCKMAN *et cetera* and ROCKMAN *ET **AL***

ROCKMAN *ET AL* is an independent research and consulting firm, specializing in studying the use and impact of technology and its roles in education. The company consults with corporations, state and federal agencies, and educational organizations on research, evaluation, and policy development that advance the application of technology to meet educational and business learning needs. ROCKMAN *ET AL* undertakes local, regional, and national studies of technology's role in school reform for both public- and private-sector clients. Saul Rockman established ROCKMAN *ET AL* in 1990 after leaving Apple Computer where he was Manager of Education Research.

ROCKMAN *et cetera* is a not-for-profit (501(c)3) corporation, associated with ROCKMAN *ET AL*, and was established in 2000 to receive funding from foundations and state and federal programs that will only fund not-for-profit entities. Its goals are to undertake and collaborate on educational research, develop research-based policy papers, and conduct programs in education and technology for both formal and informal learning. The focus of its work is on improving access to, the use and impact of technology for learning, and creating strategies for increasing equity of access of technology and telecommunications.

Current and recent clients of ROCKMAN *ET AL* include: California Department of Education, Classroom Connect, Compaq Computer, Co-nect Schools, the Corporation for Public Broadcasting, Harvard Graduate School of Education, Indiana's Buddy Project, Indiana Department of Education, Microsoft, National School Boards Association, Scholastic, Public Broadcasting Service, Toshiba, and numerous U.S. Department of Education and National Science Foundation projects ranging from Technology Innovation Challenge Grants to FIPSE projects, to Bill Nye, the Science Guy.

Current and recent clients of ROCKMAN *et cetera* include: The Joyce Foundation, The Math-Science Network, and Saving Our Sons.

The offices of both companies are located in San Francisco, California, Chicago, Illinois, and Bloomington, Indiana; the companies have working relationships with contractors, university faculty, and consulting groups in all regions of the country.