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**Bay Area Science Education Collaboratory Project:
Final Report**

**Submitted to:
The William and Flora Hewlett Foundation**

Hewlett Foundation Grant #2002-7795 to:

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In Collaboration with **DesignWorlds for Learning, Inc.**
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October 1, 2003
(updated March 30, 2004)

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“At the daybreak of this new century and millennium, we are convinced that the future well-being of our nation and people depends not just on how well we educate our children generally, but on how well we educate them in mathematics and science specifically.”

Before It's Too Late
The Glenn Commission, 2000

I. Introduction

The goal of the Bay Area Science Education Collaboratory Project, funded initially by a grant from the Hewlett Foundation, is to help improve science teaching and student learning in Bay Area middle schools, especially for schools in underserved communities. In particular, our goal is to help Bay Area middle school science teachers be even more successful helping their science students learn science by using the combined \$1 billion of virtual and actual science learning resources in Bay Area science-technology museums and related educational outreach programs—and to align these diverse resources with grade-level appropriate California state science content standards.

II. Background: California and National Context

DesignWorlds and ROCKMAN *et cetera* conducted initial needs assessment research related to informal science learning resources in the San Francisco Bay Area from October, 2001 – March, 2002, funded by the Hewlett Foundation¹. Our research found that the science and technology museums and other informal science learning institutions in the greater San Francisco Bay Area provide a wealth of existing formal and informal science learning resources, including: hands-on interactive exhibits, online information (e.g.

¹ Kahn, T.M. & Rockman, S. (2002). *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.*. Final Report to the Hewlett Foundation on Grant #2001-7331. Project information and report available for download at: http://www.designworlds.com/Hewlett/BA_ScienceCollab/index.html

home and school experiments, design challenges and lesson plans), webcasts, Internet radio, and other interactive experiences. However, this combined resource still remains vastly underutilized by any but the most experienced and motivated science teachers. Our research found that these resources are underutilized, not because teachers are unaware of these museums and institutions, or for lack of museum-based information on the web, but rather, because:

- Science learning resources with a target middle school audience are difficult for teachers to find online.
- Teachers have very little time to find appropriate online museum resources to integrate into their science curricula.
- Many science and technology museum websites do not provide easy-to-use correlation of their resources with the California science content standards at various grade levels. In addition, there are currently no other websites (other than the Collaboratory) that show the synergy of using multiple Bay Area museums for use in the day-to-day science curriculum, using a teacher-friendly and easy-to-use web interface.

As part of our final report on this research to the Hewlett Foundation², we recommended a pilot project to co-develop with teachers an initial prototype of a web-based resource of exemplary museum and other web science teaching and learning content and resources for use by Bay Area middle school science teachers. The development of a Bay Area Science Education Collaboratory was proposed as one major part of a solution to this dilemma. The Collaboratory was to be designed as an ongoing resource to help San Francisco Bay Area middle school science teachers find, utilize, and integrate high quality museum exhibits and other online museum learning experiences and resources into their science curricula, and to help improve their students' active learning, motivation, and achievement in science. Thus, the key stakeholders for our current Collaboratory are science teachers in the middle grades (5-8), especially those teachers who work with traditionally under-served students; science students; and mentors, parents and guardians.

The development of the Science Collaboratory is in direct response to the urgent need to improve the science literacy and learning of all California students at a time of disturbingly low levels of student academic achievement in science: For example, in 2001, California 4th and 8th grade students scored near the bottom of all state rankings in science achievement, as measured by the National Assessment of Educational Progress (NAEP, also known as "The Nation's Report Card")³. Similar disappointingly low levels

² Kahn & Rockman, (2002), *Ibid*.

³ For NAEP 2000 science results, see <http://nces.ed.gov/nationsreportcard/science/> For fourth grade, California ranked at the bottom nationally, tied with Mississippi, Virgin Islands, Guam and American Samoa. Results in eighth grade were similar, with California scoring at an equally low level, along with Hawaii, Louisiana, and New Mexico, as well as the states listed above³

of American student performance and achievement in 8th grade science and mathematics have also been noted by the Trends in International Mathematics and Science Study and Repeat Study (TIMSS and TIMSS-R)⁴.

The approach taken by the Science Collaboratory is also in line with national and international trends of museums to provide more programs and better access to their resources for use by K-12 teachers and students: For example, according to the most recent survey (2002) of over 15,000 U.S. museums (of all kinds) by the federal Institute of Museum and Library Services (IMLS), the median percentage of museum operating budgets spent on K-12 educational programming has increased four-fold since 1995, with over \$1 billion spent on educational programming in 2002 alone. Over 72% of museums now use the web for some kind of online teaching and learning, and 58% communicate regularly with teachers using email. In addition, 71% of these museums now actively work with curriculum specialists “to tailor educational programming to support school curriculum standards.”⁵

Within the science-technology museum communities, meeting the needs of teachers by aligning museum learning programs with state and national science and technology education standards is increasing dramatically. These trends are also supported by educational researchers and major science educators who have been advocating for “bridging the gap” between informal and formal science learning, including making stronger connections between the resources of informal science institutions and the National Science Education Standards⁶ (Hofstein & Rosenfeld, 1992; Bybee, 2001)⁷. Finally, by 2006-2007, annual state monitoring of student progress in science achievement mandated by the federal “No Child Left Behind” Act and implementation of cooperatively-developed, international benchmark assessments of both science knowledge and performance by the Organization for Economic Cooperation and Development (OECD) are already beginning to re-engage the focus of schools on the importance of science literacy.

III. Collaboratory Activities and Progress (2002 – 2003)

⁴ For 1999 TIMSS-R results, see: <http://nces.ed.gov/timss/results.asp> and <http://nces.ed.gov/timss/highlights.asp#difference8>

⁵ A summary of the Institute of Museums and Library Services (IMLS) 2002 survey, *True Needs, True Partners*, may be found at <http://www.imls.gov/whatsnew/current/012903.htm> and the full publication may be downloaded at www.imls.gov/pubs/pdf/m-ssurvey.pdf.

⁶ National Research Council (1996), *National Science Education Standards*. Washington, D.C.: National Academies Press.

⁷ Hofstein, A. & Rosenfeld, S. (1996), Bridging the Gap Between Formal and Informal Science Learning. *Studies in Science Education*, **28**, 87-112.

Bybee, R. W. (2001). Achieving Science Literacy: Strategies for Insuring that Free-Choice Science Education Complements National Formal Science Education Efforts. In J. H. Falk, Ed. (2001). *Free-Choice Science Education: How We Learn Science Outside of School*. (New York: Teachers College Press, Columbia University), 44-63.

Over the past year and in close collaboration with 10 excellent Bay Area 6th grade science teachers, DesignWorlds has co-designed a very teacher-friendly or “light switch-easy” web-based interface and an initial prototype of a 6th grade Collaboratory web learning and instructional resource for teachers, drawing from the resources of six Bay Area museums and focusing on earth science-related topics aligned with California’s Sixth Grade Science Content Standards.

This project has accomplished the following since the award of the grant in June, 2002:

A. Six San Francisco Bay Area science-technology and youth museums enthusiastically agreed to participate:

- Chabot Space & Science Center, Oakland
- Children’s Discovery Museum, San Jose (BioSITE educational outreach program)
- The Exploratorium, San Francisco
- Lawrence Hall of Science, U.C. Berkeley (LHS)
- The Tech Museum of Innovation, San Jose
- University of California Museum of Paleontology, U.C. Berkeley (UCMP)

B. Ten active, participating sixth grade or middle school teachers and one advisory teacher agreed to participate from the following schools (see also: http://www.human-landscaping.com/BA_collaboratory/teachers.html)

Seth Bramble: Foothill Intermediate School, Mt. Pleasant Elementary SD, San Jose (IISME Fellow, Intel Corp., 2002-2003)

Melissa Duran: Hoover Middle School., San Jose USD (Tech Fellow)

Tanya Rivers: John Muir Middle School, San Jose USD (CDM BioSITE participant)

Oswaldo Rubio: Sherman Oaks Community Charter Elementary School, San Jose, Campbell Elementary USD (Featured speaker for the George Lucas Educational Foundation)

Shana Covell: Westlake Middle School, Oakland USD (also enrolled in Hewlett Foundation-funded Center for Teaching Excellence & Social Justice M.A. and credential program, USF)⁸

⁸ Shana Covell has recently moved to New York, where she is teaching mathematics in the New York City schools. She remains one of the Collaboratory’s most enthusiastic teachers and hopes to continue her participation as she pursues a doctorate in the gifted education in the future. Her comments may be heard on one of the Collaboratory radio interviews with Jerry Kay (KALW/Earth News Radio) at: http://www.scienceinterchange.org/en_audioarchive_0503.html

Natalie Mann: Montera Middle School, Oakland USD (Chabot Teacher Scholar)

Paul Hynds: Riverview Middle School, Mount Diablo USD (Bay Point) (former SEPUP staff member, LHS; teacher advisor to Chabot)⁹

Susanne Marvit: Presidio Hill School, San Francisco (Exploratorium Teacher Institute participant)

Anne Monk: Katherine Delmar Burke's School, San Francisco (Advisor, UCMP; Exploratorium Teacher Institute; founder of education program for Marine World-Africa USA)

Richard Delwiche: Benjamin Franklin Middle School, San Francisco USD (Exploratorium Teacher Institute participant and mentor teacher)

Advisory Teacher:

Ronna Voorsanger: Roosevelt Middle School, San Francisco USD

Several of the participating teachers, or their schools have also participated, or are currently participating in other Hewlett Foundation-funded education grants or projects:

- **Bay Area School Reform Collaborative (BASRC):** Osvaldo Rubio, Sherman Oaks Community Charter Elementary School, San Jose; Ronna Voorsanger, Roosevelt Middle School, San Francisco
- **Industry Initiatives in Science & Math Education (IISME):** Seth Bramble (Foothill Intermediate School, Mt. Pleasant Elementary SD, San Jose)
- **Exploratorium—Center for Teaching and Learning (Teacher Institutes):** Richard Delwiche, Benjamin Franklin Middle School, San Francisco; Susanne Marvit, Presidio Hill School, San Francisco; Anne Monk, Katherine Delmar Burke's School San Francisco; Ronna Voorsanger, Roosevelt Middle School, San Francisco
- **University of San Francisco—Center for Teaching Excellence and Social Justice (Teach for America):** Shana Covell, Westlake Middle School, Oakland
- **WestEd—multiple projects in school reform, project-based learning, technology, and science & math education**

C. A rotating site-based museum model for professional development was established, with four one-day design and professional development workshops held at each of four of the participating museums. Nine of the 10 teachers participated at all four workshops.

⁹ Paul Hynds has recently moved to Monterey, CA, and he's now teaching biology at Gilroy High School. He also remains very interested in continuing to participate remotely in the Collaboratory.

1. The Science Collaboratory project was launched at the Exploratorium on August 18, 2002 with eight teachers, four Exploratorium staff members, and four Collaboratory project staff/consultants participating. Project staff used this workshop to establish the model for the other museum-based workshops at three of the other participating museums. Each workshop included floor tours of specific exhibits and discussion of the specific pedagogical approach and science content/process focus of each museum; demonstrations of low-cost “hands-on” activities by both participating teachers who had been resident at the museums, as well as presentations of museum-created curriculum and web resources by museum staff. Teachers use of the web resources of each museum, followed by extensive discussions and design feedback about teacher needs for effective access to and use of these museum web resources were a key and common element of each workshop.

2. Following the project launch workshop, subsequent design and professional development workshops were held at the following participating museums:

- **The Exploratorium (November 6, 2002)**—for three teachers who joined the project in September)
- **Chabot Space & Science Center (November 18, 2002)**—included participation in their Challenger Center space mission simulation) and first iteration of Collaboratory web user interface.
- **The Tech Museum (February 7, 2003)**—included premiere of the second Collaboratory user interface and the first use of the online database and remote entry routines for the Standards Matrix and topic map portions of the Collaboratory, as well as extensive discussion of criteria for selection of the “best” museum and web resources.
- **LHS (March 20, 2003)**—including demonstrations of hands-on activities from three LHS-developed science curricula (Full Options Science System (FOSS), Great Explorations in Math & Science (GEMS), and Science Education for Public Understanding Program (SEPUP); demonstration of the third Collaboratory user interface, which is now still in use.. The LHS workshop also included presentations of web resources by the Children’s Discovery Museum BioSITE outreach program and UCMP, as well as an extended discussion with 15 project, web, staff and other science education staff professionals from LHS (including its new Director, Dr. Elizabeth Stage), Exploratorium, CDM, and UCMP about how museum web resources can be made more accessible and easier to teachers to use in their classrooms.

3. Two graduate Continuing Education Units (CEU) credit was arranged for all participating teachers, through Dr. Kahn’s adjunct affiliation with Foothill College through the online LINC courses of the Krause Center for Innovation. The prototype and professional development model has led to the design of two courses that are now being offered for other Bay Area teachers on using the Collaboratory model for both improving science teaching and teacher-student collaborative learning of science.

C. Web based resources and a new kind of web interface and database architecture and resources for the initial Collaboratory pilot were established

1. A very experienced team of consultants was selected as co-designers, architects, and managers of the Collaboratory development process. Expertise also included digital video and graphic storytelling, science and museum/informal science education and teacher professional development. In addition to DesignWorlds co-founders, Dr. Ted Kahn and Frona Kahn, the Collaboratory design team included: Bill Daul, Eileen Clegg, Jack Gottsman, Bob Kahn, Jack Park, and Dr. Sherman Rosenfeld; Alan Bernard also joined the team in the latter part of the school year. Information on the project team may be found at:

http://www.human-landscaping.com/BA_collaboratory/project-team.html

2. An online discussion forum and listserv was established via EdGateway.net (WestEd--Eisenhower Regional Consortium for Math & Science Education), as well as through Yahoo Groups.
3. Formative evaluator selected: Dr. Loretta Kelley, experienced, independent contract educational researcher and evaluation specialist has worked extensively with WestEd and many projects on teacher professional development and technology in education..
4. Initial baseline teacher survey developed and posted online; received 100% response from the participating teachers. Results were synthesized and distributed to project staff
5. Researched and analyzed several museum web interfaces for standards alignment and links to grade-appropriate lesson plans, both individual Bay Area participating Collaboratory museums and others (e.g., Smithsonian, Marco Polo Foundation).

D. Developed extensible web architecture for both prototype and future expansion of Collaboratory web infrastructure Thanks to the architectural and “open source” web development expertise of Jack Park, the Collaboratory “wiki” web architecture includes advanced features for future growth, such as XML topic maps (ways of cross-linking different topics, resources, and information about standards), teacher and topic web logs (“blogs”), and a very teacher-friendly web interface for remote entry and access of museum and web resources into/from an online MySQL database and Standards Matrix. This environment allows for scalable online community growth and interactions as Collaboratory teachers develop their facility in using and contributing to the Collaboratory., thus supporting the Design Worlds three-stage managed online Collaboratory professional development communities: Novice Users, Content Contributors and Coaches, and Mentors/Content Editors/Evangelists.

- E. Iteratively prototyped, designed and tested the web interface, content and standards database, and online community architecture for The Science Collaboratory web site. A special focus was on developing a “light switch easy” visual and intuitive interface that allows teachers access to the best material from multiple museums that are no more than three (3) clicks away from the home page (our own teachers’ design constraint). This same visual and intuitive interface (thanks, in large part, to the visual storytelling talents of Eileen Clegg and the web interface design skills of Bill Daul) can be used by parents, mentors, students, and students/faculty in colleges/universities, for new curriculum development in emerging areas of science and technology (e.g., biophotonics, nanotechnology, marine bionics), as well as for contributions to the Collaboratory’s “learning ecosystem.”

(Note: The current web-based demo of the Collaboratory (using museum and other web content aligned with the “Plate Tectonics” and “Shaping Earth’s Surface” California 6th grade science standards) may be found at: www.designworlds.com/BA_collaboratory/).

All 10 of our initial participating teachers, as well as some of their 6th grade teacher colleagues, used this site during the 2002-2003 school year.)



Bay Area Science Education Collaboratory Demo Home Page

http://www.designworlds.com/BA_collaboratory

(See also “Bay Area Science Education Collaboratory Overview” in Appendix).

Note: The Collaboratory teacher co-designed web interface has now gone through three major design iterations and has been joined with an extensive online MySQL database for the 6th grade science content Standards Matrix that allows very simple

remote user entry of web URLs and descriptors, via web forms. (See attached overview document to see example of teachers' design criteria of "no more than 3-clicks away from home page to resources" solution).

- F. **Selected seven key kinds of learning resources, as well as seeding initial 6th grade science content for two (2) topics from the seven standards for California 6th grade science: "Plate Tectonics" and "Shaping Earth's Surface.** Both of these topics, which have substantial linkages to earthquakes, volcanoes, the nature of plate movement, rivers and erosion, and related earth science topics, were chosen to seed the initial content prototype of web-based links to participating Bay Area museum resources, all aligned to standards. The seven kinds of resources defined by the teachers for this Collaboratory include:

Lesson Plans (on museum web sites or those that use museum resources);

Hands-On Demos & Activities

Homework Resources for parents and students

Projects (for science fairs or at-home experiments and explorations)

Field Trips (both physical and virtual museum visits, and pre-visit and post-visit activities)

Assessment resources for teachers to use in assessing student learning of science, and

Resources ("Best of the Web"—i.e., not tied to participating local museums).

- G. **Seeded the Collaboratory database and nominated and selected "best" content for 6th grade (focus on earth sciences):** With nominations by teachers, museum education staff, and DesignWorlds staff, there are now over 100 links in the 6th Grade Standards Matrix database to museum and best-of-the-web resources for the Plate Tectonics and Shaping Earth's Surface (CA 6th grade science standards #1 and #2, respectively). The average or novice teacher only sees the two top-rated resources for any given standard and subtopic during a given year; voting for "best choices" is the repeated or new nominations are taken once each year to keep this site dynamic and current. However, all the links that more experienced teachers find remain in the database. (See: <http://www.nexist.org/hf/Standards/>) Teacher review and selection of appropriate content material for the site, as well as choice of the "best two" resources for a given subtopic and resource types (e.g., Lesson Plans, Hands-On Demos, Resources, etc.), were essential, but time-consuming contributions to the effort.

- H. **Planned and held a highly successful Educational Advisory Board Meeting at Mills College January 21, 2003;** added Dr. Herb Their to the Advisory Board, a leading, international expert in science education & curriculum development and recently retired co-director of many NSF-funded K-12 inquiry-based science materials development projects over the past 35 years at the U.C. Berkeley Lawrence Hall of Science (SCIS, OBIS,

ChemStudy, GEMS, SEPUP, etc.). For a full list of members of the Educational Advisory Board, see:

http://www.human-landscaping.com/BA_collaboratory/advisoryboard.html

- I. Identified a broad and deep interest on the part of other museums and regional community science alliances** (forged between the local business community and the school districts) about increasing student science literacy. Specific discussions are now in process with leaders of the San Diego Science Alliance (SDSA.org) and the Informal Science Education Alliance in Texas.
- J. Made numerous presentations about the Collaboratory at professional conferences, other science education & technology projects, and to other potential funders.** These presentations included management and research staff of the new NSF-funded Center for Biophotonics, Science & Technology (UC Davis and Mills College, for K12 learning activities development); a representative local group from the nanotechnology and education group; and three senior NSF program directors in K12/informal science education, and the National Science Digital Library (NSDL.org) project. In May, 2003, three short radio broadcasts about the Collaboratory were produced for NPR affiliate station KALW by Bay Area radio and media personality, Jerry Kay, via EarthNews Radio (ENN.com) and ScienceInterchange.org (web archives are now online). A brief presentation was made to members of the Bay Area Science Alliance (BASA.info), a WestEd, and the Eisenhower Regional Consortium-sponsored coalition of over 100 Bay Area science education providers and informal science learning institutions.

A special Collaboratory session presentation was made by Dr. Kahn in his role as the inaugural NMC Fellow of the New Media Consortium (NMC.org) at its annual member conference in June, 2002, and an invited poster session presentation was also made at the first Bay Area Institute of the NSF-funded Center for Informal Learning & Schools (CILS), held at U.C. Santa Cruz in August, 2003. A special invited presentation (and follow-up discussions) has been made to executive staff and members of the San Diego Science Alliance (SDSA.org), and a proposal to develop a Texas Science Collaboratory will be followed up by a presentation to the board of the Informal Science Education Association (ISEA) in Texas. A presentation will also be made at the annual Fall conference of Computer-Using Educators on October 25, 2003.

Several presentations have been made to prospective funders (including an invited presentation and proposal submitted to the Elizabeth & Stephen Bechtel Jr. Foundation) and other key individuals. The following two quotes are representative of some of the reactions to these Collaboratory presentations:

“It’s about time someone did something like this!” (Dr. Joe Oakey, former high school principal & school superintendent, former Director of Far West Laboratories; founder and former CEO of the Autodesk Foundation and internationally recognized expert in project-based learning in science and technology).

“Bill [Hewlett] would have really liked this.” (Bob Grimm, key longtime supporter of The Tech Museum; co-inventor of “The Tech Challenge,” and longtime former employee of HP and past director of HP Labs).

- K. Over 8 hours of digital video was shot at four of the museums.** This included teacher workshops, as well as school visits of classes of students of two participating Collaboratory teachers (Covel and Duran) at Chabot and the Tech Museum, respectively. Apple Computer has invited the project’s participation on their Apple Learning Interchange (ALI) for possible development of a new kind of online “exhibit” on “Collaboratories,” either to be published on Apple’s ALI site or as an independent ALI Affiliate <http://ali.apple.com>. Because our focus this year was on developing the Collaboratory process, web architecture and interface, this video and its associated text annotations has not yet been edited for the online ALI exhibit or other web-based access. However, several short example clips for different museum exhibits and activities (both for students and teachers) are available on CD upon request.
- L. The formative evaluation report by Dr. Kelley provided baseline information about the teachers’ background in science, teaching experience, and familiarity with museums and web-based resources. It also provided more detailed information about teachers’ reactions to this year’s collaborative design and action research prototype, especially in the area of teachers’ use of this web resource for their own science teaching (see “Evaluation” below).** Some of the teachers had already encouraged their other teaching colleagues in their schools to use this web resource, albeit in a very preliminary state, for their own teaching, and several teachers in Westlake Middle School in Oakland did so during the latter part of the 2002-2003 school year.

The following two quotes by two of the teachers reflect the general continued enthusiasm and interest in both the Collaboratory as a resource, as well as a form of their own professional development in science:

“Since the meeting [Chabot], I have explored all of the museum websites in our project. I have found links and resources to things that I did not know were there. I have found a few lesson plans and links (especially at the Exploratorium website) for activities and demos I’d like to try out in my classes. I have used non-museum web sites that were brought up in the discussions. I love the website that offers a lesson a week! I’ve found some great resources there. Also, I liked the website that one of the teachers worked on with their

school's science teachers. There were some great practical resources they made available.”

“I am really happy to be a part of this project as I feel it is one of many crucial approaches to information filtering that will be a necessary next step in our information revolution. There is just too much out there that cannot be accessed easily by more specific requirements that exist on current search engines and the type of narrow-casting that we hope to do for sixth grade science teachers has enormous value in making wonderful resources more readily useable for all of us.”

IV. Evaluation

The evaluation provided some descriptive information about the ten teachers in the initial Collaboratory and their reactions to participating in the development and implementation process.

The teachers form a diverse group with respect to their teaching experience and science background and, most relevantly, their experience with the Bay Area science museums and web-based science resources. Prior to this project, nine of the ten teachers had visited at least one of the museums, but fewer had taken their classes to the museums for field trips, participated in the museums' professional development, or visited their web sites (except for the Exploratorium's web site). Those who had participated in the museums' professional development reported improving their content knowledge and pedagogical skills, but did not increase their knowledge of national and state science standards.

Whatever their background, all teachers have grown and learned from their participation in the Collaboratory. The participants clearly benefited from their museum-based activities, but were most enthusiastic about their engagement in the Collaboratory process. Both formal and informal sharing of web-based materials and other exchanges have contributed to evolving classroom practice and the incorporation of new curriculum resources in the class. The project's listserv also served as a source of information.

Throughout the course of the project the teachers reported that their and their students' use of museum web sites increased and that their satisfaction with the Collaboratory web site grew. Several teachers indicated the value of the project web site as a starting point by saying “The project web site is the only way to find stuff.” or “I always start a unit with our web site.” They indicated a variety of roles they would like to play in the continuation of the project, especially disseminating information about the web site to other teachers and to science education groups.

V. Future Plans: Bay Area Collaboratory Phase II and Satellite Collaboratories

Phase II will include the following major goals and activities:

Priority 1 (full middle grades model):

1. Complete web visual interface and 6th grade content for the other remaining five content standards, as well as resources for projects, field trips (virtual and physical) and assessment for seven 6th grade standards.
2. Test and evaluate use of the 6th grade Collaboratory with at least 30-40 Bay Area middle school classroom teachers (as well as our original co-design teachers)
3. Complete development of robust underlying web-based architecture and interchange between web-based database and web site for average teacher use; this includes exploring use and integration of more automated web search and data mining functions, such as Google News and RSS.
4. Get signed commitment to participate in the Bay Area Science Collaboratory from 5-10 middle (or elementary) schools serving underserved students.
5. Establish the infrastructure for assessment for the Collaboratory, with following goals:
 - a. 10% to 15% improvement in science literacy and academic achievement compared to the average of the past three years of achievement for students of each teacher. (Learner Productivity = More achievement in the same time.) Efficacy => demonstration of reliability as in biotech.
 - b. Measurable and observable improvement in science literacy behaviors (performance) and science content knowledge, i.e., beyond the skills and knowledge demonstrated prior to the use of The Science Collaboratory. (Learner Productivity = More observable science knowledge in the same time.) Efficacy => demonstration of reliability as in biotech.
6. Implement the annual Collaboratory content enhancement review process to ensure that science teachers and students have access to the best appropriate museum materials; focus on providing the two best resources from among the different museums for each subtopic of the grade-level standards each year (for the average teacher or parent use), as well as an online, continuous “learning ecosystem” for more experienced teachers, mentors/master teachers, higher education, and museum educator participants. This also includes encouraging and supporting experienced teacher/mentors creation of web logs, discussion of best practices, and use of short digital video clips for demos and discussion.

Priority 2

1. Complete initial design and implementation of graphic interface, professional development workshops, and content selection for 7th grade (focus on life

- sciences), 8th grade (focus on physical sciences and astronomy) and 5th grade (order of these grades TBD, dependent on funding).
2. Plan and develop replication and scalable model for developing regional collaboratories in other areas of California (e.g., San Diego), as well as other states (e.g., Texas)
 3. Explore and prototype linkages of Collaboratory resources to complement and augment one or more grade-level appropriate NSF-funded science materials/curriculum materials that have been approved or adopted for multi-school use (e.g., Science Education Program for Public Understanding (SEPUP); Full Options Science System (FOSS)).
 4. Summative evaluation of middle school teacher use of Collaboratory with at least 100- 150 Bay Area science teachers in middle grades (30/grade).
 5. With the encouragement of school administrators (and NCLB), linkages with literacy and language arts need to be established.

We acknowledge that there are many excellent individual examples of providing access to learning resources through museum web sites, and that many of the participating museums are improving their own web resources for use by K-12 teachers. We feel that the Collaboratory provides external value-added to these efforts, as it is co-designed and co-developed by and for teachers, and it does not owe allegiance to any one museum or institution. We have already received feedback from some of the museum educators or web developers who work directly with teachers that the Collaboratory process, to date, has provided this kind of value for their own work.

Timeline and Funding

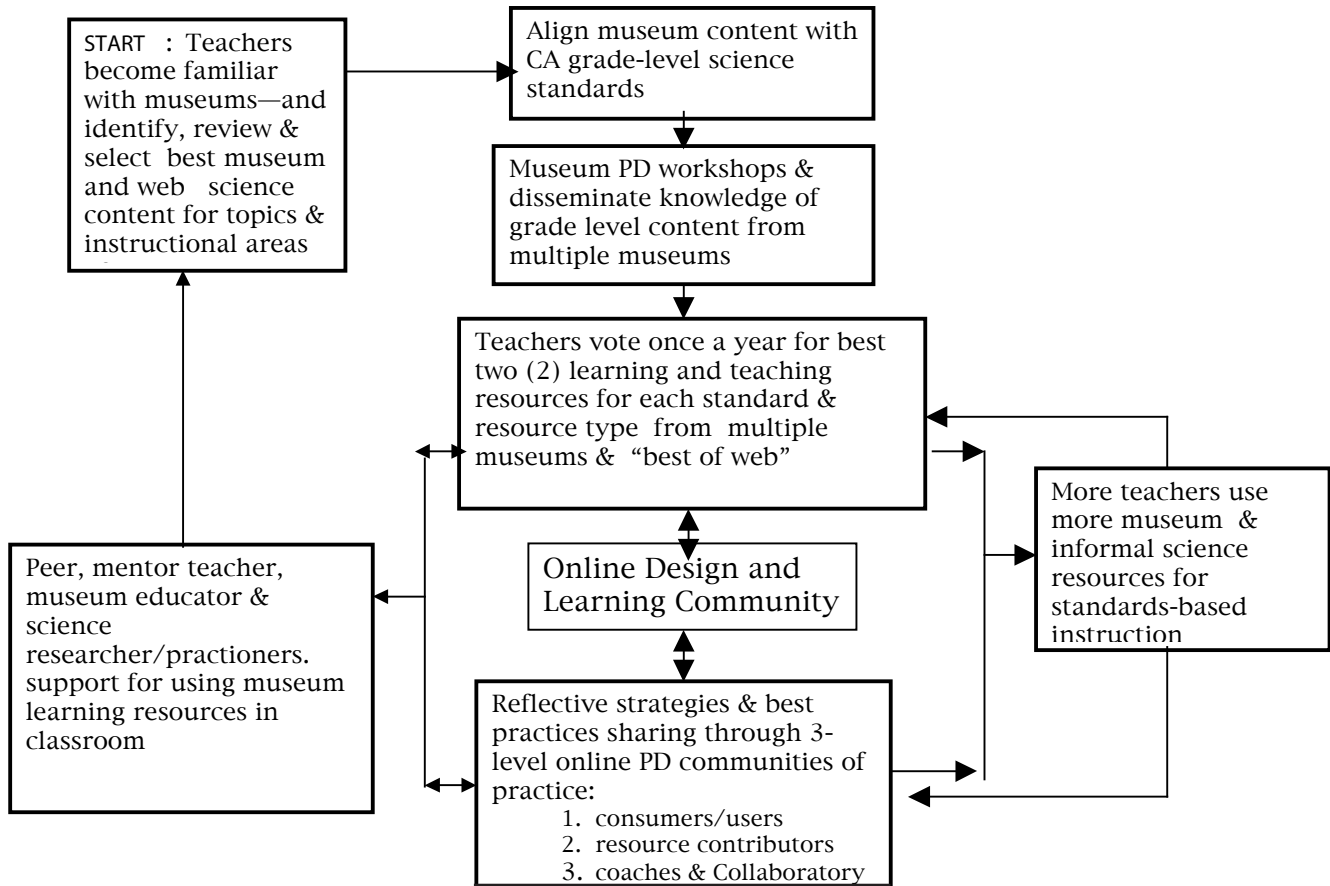
We are proposing a 20-24 month action research, development and evaluation effort, which we hope to begin as soon as possible, and which will span the 2003-2005 school years. The project will include selection of new teacher and school participants (both for the 6th grade completion, as well as (pending funding) for 7th, 8th, and 5th grades); standards content graphic interface design and focus group sessions, and iterative design and testing of the web interface and content for this system for the new grades, in parallel with the continued inventory, selection, and correlation/articulation of the best museum resources, aligned with the science education standards. We hope to hold summer teacher professional development workshops around the use of this tool during the 2003-2004 school year, and Ted Kahn will be teaching a course for new teachers wishing to use the Collaboratory through Foothill College's Krause Center for Innovation.

We were invited to submit a proposal to The S.B. Bechtel, Jr. Foundation requesting their partial support of the Bay Area Collaboratory. Their board reviewed our proposal and awarded us an 18 month grant in December, 2003, in partial support of Phase II of The Bay Area Collaboratory. We are also pursuing targeted support from several other Bay Area foundations (including the Genentech Foundation for Biomedical Sciences) to further the Phase II effort, whose total overall budget is estimated at \$400,000 - \$450,00 for two years. Active discussions also continue regarding possible development of other regional or "satellite" Collaboratories in San Diego and Austin/San Antonio (where we

have already submitted an initial proposal for a pilot Texas Collaboratory to the Austin Community Foundation in collaboration with the Texas Informal Science Education Association (ISEA), and we plan to submit proposals to both the NSF and IMLS in late 2004 and 2005.

Building a Web-Based Community Science Learning & Teaching Garden: DesignWorlds' Science Education Collaboratory Development Process & Feedback Cycle

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The California Science Education Collaboratory

*A story of hope about students
enthusiastically learning science*

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Potential Energy

Middle school science teachers in California have push-button access to over a billion dollars worth of web learning resources offered by local science/technology museums.

But which of the thousands of buttons should 6th grade science teachers push when they need a lesson plan on plate tectonics? Which buttons lead to the best genetics projects for 7th graders? Where do you find astronomy-related activities that fire the imaginations of 8th graders?

Searching through the museums' wealth of information is fascinating—if you have the time.

Few middle school teachers have the time to click through even a fraction of the available web pages. So a billion dollars worth of educational resources goes largely unused by the people who could use it most. Meanwhile, California middle and high school students rank near the bottom of the national rankings in science achievement.

Electrifying Science Education

The solution looks like this—a window on the available resources that shows exactly what Bay Area teachers need for every part of their California standards-based science curriculum. To find the plate tectonics lesson plan, click “plate tectonics.”

Bay Area Science Museum Learning Collaboratory

San Francisco Bay Area Museum Resources
By & For California 6th Grade Science Teachers
Thanks to the William and Flora Hewlett Foundation

http://www.designworlds.com/BA_collaboratory/

On the next page, click “Volcanoes and Earthquakes”—and then either “Lesson Plans,” “Demos/Activities,” or one of the other resource buttons. In a couple of clicks, you have exactly what you need:

Bay Area Science Museum Learning Collaboratory

PLATE TECTONICS

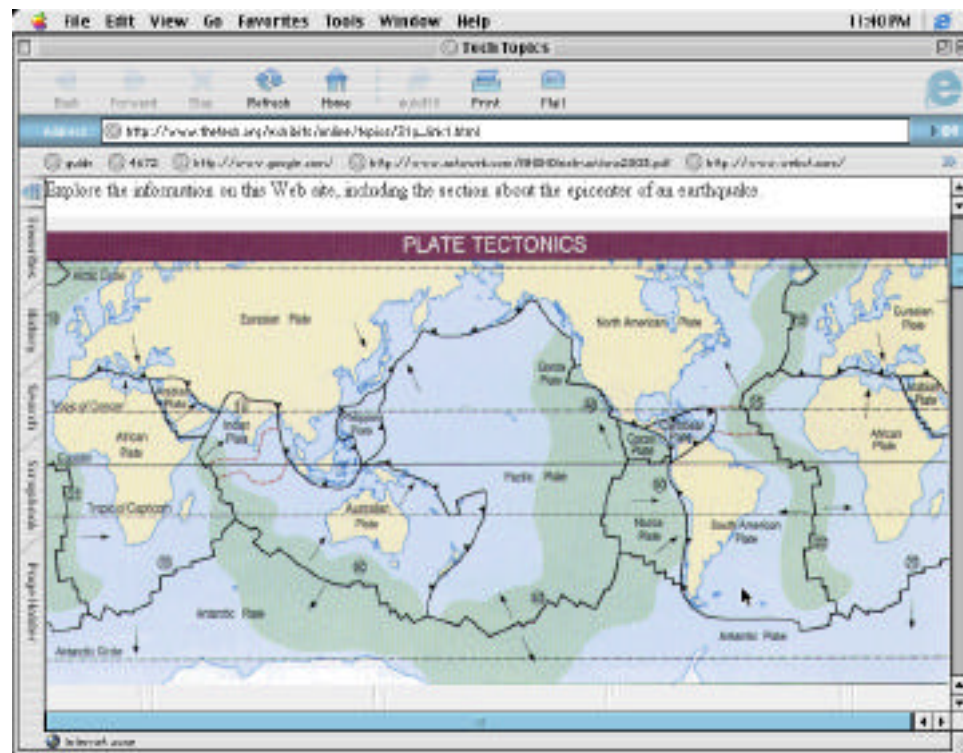
San Francisco Bay Area Museum Resources
By & For California 6th Grade Science Teachers
Thanks to the William and Flora Hewlett Foundation

One resource might be this web page from the Exploratorium in San Francisco...



© 1999, 2003 The Exploratorium

...or another might be this web page from the Tech Museum in San Jose:



© 2002 The Tech Museum of Innovation

Implementing the Bay Area Science Collaboratory

To make this system work, someone has to identify the right resources. DesignWorlds for Learning proposes to have a team of exemplary science teachers choose the best museum and web resources—lesson plans, hands-on activities, homework resources, student projects and other material that the teachers themselves find most useful. The expert teachers will draw from a variety of local science museums and select specific standards-based learning content.

Learning-technology experts—scientists and science educators—and web developers can then collaborate with the science teachers to develop web pages like the ones shown here. Every button connects to the two current best choices selected by expert science teachers. And these pages are not just for teachers. Students, parents, mentors and others can use these links to find trustworthy resources.

Ready access to these resources makes it much more likely that teachers can help their students exceed the learning goals of state and national science content standards. The Collaboratory provides a direct way to influence measurable academic achievement in science.

As a result:

- Bay Area middle school science teachers get just what they need, just when they need it.
- Parents and tutors get information they can trust.
- Students get the best available science education.

- Museums get feedback that helps them refine their resources to suit educational needs.
- The Bay Area gets a better opportunity to bring science education up to the top ranks nationally, where it should be.

Standards	Lesson Plans	Activities/Demos	Homework	Project	Field Trips	Assessment	Resources
<p>Plate Tectonics and Earth's Structure</p> <p>1. Plate tectonics accounts for important features of Earth's surface and major geologic events.</p> <p>1.a. Students know evidence of plate tectonics is derived from the fit of the continents; the location of earthquakes, volcanoes, and midocean ridges; and the distribution of fossils, rock types, and ancient climatic zones.</p>	<p>#2 UCMP (July/5): Sea-floor Spreading</p> <p>#1 UCMP/USGS (July/5): Continental Drift</p>	<p>LWL: Forces that Shape the Bay</p> <p>UCMP: Geology/Plate Tectonics</p> <p>#1 Exploration: Breakup of Pangaea (Video)</p> <p>LHS (2005): FOS/Wea Earth Real-Data/ase activities</p> <p>#2 Exploration (Sam): Magnetic Rocks</p>	<p>#2 Exploration (20-40): Antarctica</p> <p>#1 Field Trips</p> <p>#1 UCMP/USGS (July/5): Plate Tectonics</p>		<p>#1 LHS: Forces that Shape the Bay</p> <p>#2 LHS: Forces that Shape the Bay</p>	<p>Plate Tectonics Assessment Rubric</p>	<p>Frontier Hall (Thruout) Plate Tectonics #11</p> <p>#1 Ocean Center: National Park: Oceanic Trenches (1/05) #2 Design Labs Online: Virtual Lab Activities</p>
<p>1.b. Students know Earth is composed of several layers: a cold, brittle lithosphere, a hot, convecting mantle, and a dense, metallic core.</p>	<p>#1 Oakland USD (2004) Chobot-LHS</p> <p>#3 Oakland USD (2/04)W: Journey to the Center of Earth</p> <p>#2 UCMP (July/5): Online course for 6th grade science</p>	<p>#1 UCMP (July/5): Sea Floor Spreading</p>	<p>#2 Oakland USD: Travel to Earth Center</p> <p>#1 The Tech (2001): Structure of the Earth</p>		<p>Chobot: Planetary Landforms Exhibit</p>		<p>MPs: Graph of Earth's Layers</p> <p>Chronicle Newspaper in Education (6/Ando/LHS): Earth's Inner Foot</p>
<p>1.c. Students know lithospheric plates slide at continental and oceanic crust.</p>	<p>#1 WPI/ssa Duran: Rastoss Earth</p> <p>#2 UCMP/STUSD (July/5): Unified 6th</p>	<p>#2 UCMP: Plate Tectonics Animation</p> <p>#1 Tech (2001): Plate Tectonics</p>	<p>#2 UCMP (July/5): Sea Floor Spreading</p>	<p>#2 Exploration (DeB): Breakup of</p>	<p>#2 LHS: Forces that Shape the Bay</p>		<p>Earth Surface and Interior</p> <p>#2 USGS: This Dynamic Earth</p>

Bay Area Science Education Collaboratory: California Sixth Grade Standards Matrix and Museum/Web Resource Database:
<http://www.nexist.org/hf/Standards/>
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We Have Taken the First Steps

DesignWorlds for Learning, in collaboration with Rockman, *et cetera* (a 501(c)-3 non-profit corporation) has implemented some of the Collaboratory steps described here with the help of the William and Flora Hewlett Foundation and the S. D. Bechtel, Jr. Foundation, whose generous support has enabled the initial development and testing of the Bay Area Science Education Collaboratory sixth grade prototype.

The progress we have made so far hints at the Collaboratory's remarkable potential. Teachers are using our initial web pages and telling other teachers about them. With modest resources, we can deliver the bounty of learning resources of Bay Area and other California science-technology & youth museums, zoos, and aquariums exactly where it can do the most good.

Much remains to be done. We have the opportunity to inspire a new generation with the astonishments of science. We invite you to help us help us achieve this goal.

For more information, see:

http://www.designworlds.com/Hewlett/BA_ScienceCollab/index.html

Acknowledgements: Our special thanks and appreciation to: The William and Flora Hewlett Foundation and the S. D. Bechtel, Jr. Foundation; AcrossWorld Communications; Saul Rockman (Rockman, *et cetera*); Alan Bernard, Bill Daul, Eileen Clegg, Jack Gottsman, Bob Kahn, Dr. Loretta Kelley, Jack Park, and Dr. Sherman Rosenfeld; Barbara Glynn, Bob Peterson, and Bob Grimm; Jerry Kay (ScienceInterchange.org and Earth News Radio/ENN.com); the members of our Educational Advisory Board; the six participating Bay Area science-technology and children's museums, and the 10 dedicated Bay Area science teachers who have been our design partners and first users.