



city|*watershed* PROJECT

Final Evaluation

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Executive Summary

Introduction

This report is the final program evaluation of the City | *Watershed* (CW) project. CW is a community-university partnership created by the Interactive University Project at the University of California, Berkeley. The project aims to increase community involvement in and understanding of the urban watershed. CW partners from the University of California, Berkeley and San Francisco Bay Area environmental and education organizations work collaboratively to enable students, teachers, and community leaders to contribute solutions to the interrelated environmental and social problems of the San Francisco Bay watershed. Funded by a grant from the Department of Commerce Technology Opportunities Program (TOP), the CW project strategically employs emerging technologies to create engaging watershed programs and strong partnerships.

Program Goals

The CW project sought to achieve four primary outcomes:

1. Increase citizen participation in and understanding of the urban watershed, enabling community members to make significant contributions to improving the natural and social environment;
2. Facilitate greater civic engagement of the UC Berkeley campus in the surrounding community by developing and supporting ways campus faculty, students, and staff can share their work, knowledge and time;
3. Build a sustainable regional partnership of CW partners; and
4. Implement a web-based system for sharing watershed content—the Watershed Contribution Exchange—that becomes integrated into the on-going work of project partners.

Evaluation Framework and Methodology

This evaluation assesses the CW project from the beginning of the TOP grant in October 2003 through its completion in September 2006, and analyzes both the procedural aspects of the project as well as the final outcomes. The evaluation is intended to highlight programmatic successes and challenges, and to identify best practices and lessons learned that could be applied to other organizations and community-university partnerships seeking to engage citizens through environmental education and/or technological tools.

The CW project utilizes a logic model evaluation strategy. During the planning stage of the grant, program leaders in the East Bay and San Francisco as well as on campus leadership worked with the evaluation team to establish objectives and outcomes and link them to both quantitative and qualitative measures of success. Throughout the grant, the evaluation team collected and analyzed several types of data, involved as many stakeholders as possible, and utilized a variety of evaluation tools.

Program Results

CW found success in all outcome areas. CW partners engaged over 1500 students in environmental education and restoration activities in the San Francisco Bay watershed. They established and institutionalized programs for UCB students to be involved in the community, identified new strategies for involving faculty, and networked with other outreach staff on campus. CW partners built strong networks of education and

environmental partners and institutionalized their programs with their host and partner organizations. They successfully implemented the Watershed Contribution Exchange and experimented with numerous technologies for use in the classroom or as tools for communication and sharing information including a webGIS system for collecting and analyzing spatial data.

Best Practices

Based on the experiences of the project partners throughout the grant, CW core partners identified best practices and lessons learned in three areas: civic engagement, partnerships, and technology. These best practices can be used by other organizations and applied to community-university partnerships seeking to engage citizens through environmental education and/or technological tools.

Best Practices for Civic Engagement

- *Recognize the opportunities and constraints of university system:* universities have extensive resources that may be beneficial for the surrounding community but the structure and politics of the university often limits its ability to share useful resources. Examination of the motivations, incentive structures and demands on various actors in the university system can help to identify promising and realistic partnership opportunities.
- *Reward faculty and students for work in the community:* both faculty and students will have greater incentives for working in the community if they receive credit or recognition for their work. Students who receive course credit for their work are accountable for their participation and have an incentive to overcome the obstacles of scheduling and travel to work off-campus. Faculty should be rewarded or recognized for their work in the community through grant money, department service credit, and publications when appropriate.
- *Cultivate administrative support for campus outreach programs:* support and collaboration of administration legitimizes outreach work; can lead to credit for faculty participation; and minimizes political problems associated with struggles to access limited resources.
- *Develop positive relations with community partners:* community university partnerships should be non-hierarchical relationships that emphasis the ‘win-win’ aspects of the partnership.

Best Practices for Partnerships

- *Partnerships must be meaningful and productive:* meaningful and productive partnerships are built on foundations of mutual goals, clear objectives and division of responsibilities, respect, and the retention of individual partner identities while creating a unique group identity.
- *Successful partnerships depend on good logistics:* organization, communication, and scheduling are key to mitigating the difficulties of conflicting schedules and dealing with the varying timelines for funding, school years, community organization, etc. Web-based communication technologies can facilitate better communication

between partners but are only successful if they are convenient and regularly used by all partners.

Best Practices for Technology

- *Technology should be considered a tool, not an endpoint:* technology can be a valuable tool in education programs and to facilitate communication and data sharing but should not be used simply for technology's sake. In the classroom, it is important to blend technology-based activities with non-technical experiences. Technology cannot always substitute for face-to-face communication.
- *Address the technology learning curve when considering new uses and users of technology:* there is a gradient of technology familiarity and comfort among users. For example, students tend to learn and adopt new technologies relatively quickly while teachers may not be accustomed to using technology and may not be as familiar with tools. When considering new uses or users of technology, programs should be sensitive to the varied comfort-levels of users and develop different training programs for users with different technology comfort levels.
- *Consider the psychology of online communities when designing web-based tools for groups:* Consideration of the standard practices of potential users can help predict the likelihood that users will adopt technology. The design of online communities must thus consider the standard practices of users and should be tailored to the particular needs and social norms of users.
- *Use appropriate strategies for technology development:* There are two basic motivations for developing technologies: (1) to solve an existing program and (2) to innovate and explore the promise of creative new tools. Each motivation is associated with a different strategy for developing technology. Developing new technologies to solve an existing problem requires a directed and persistent strategy while innovation requires flexibility and creativity to experiment with new ideas. For successful technology development, the motivation, strategy and needs of participants in technology development should be aligned.

Introduction

The City | *Watershed* (CW) project is a community-university partnership created by the Interactive University Project at the University of California, Berkeley to increase community involvement in and understanding of the urban watershed. CW partners from the University of California, Berkeley and San Francisco Bay Area environmental and education organizations work collaboratively to enable students, teachers, and community leaders to contribute solutions to the interrelated environmental and social problems of the San Francisco Bay watershed. Funded by a grant from the Department of Commerce Technology Opportunities Program (TOP), the CW project strategically employs emerging technologies to create engaging watershed programs and strong partnerships.

This document is the final program evaluation for the CW project. The evaluation assesses the project from the beginning of the TOP grant in October 2003 through its completion in September 2006, and analyzes both the procedural aspects of the project as well as the final outcomes. The evaluation is intended to highlight programmatic successes and challenges, and to identify best practices and lessons learned that could be applied to other organizations and community-university partnerships seeking to engage citizens through environmental education and/or technological tools.

Program Description and History

The City | *Watershed* project was established in January of 2003 to increase understanding and concern for the urban watershed, and to empower citizens to contribute solutions to the social and environmental problems of the urban watershed. Under the leadership of the Interactive University Project at the University of California, Berkeley (UCB), CW brings together Bay Area community-based environmental organizations, federal resource agencies, K-12 school districts, and partners within UCB who share a common commitment to solving the interconnected social and environmental problems of the urban watershed. The CW project enhances the already successful education and restoration programs of its partners through the innovative use of technology in partner activities and by bringing the resources of the university to community partners.

In the summer of 2003, CW received a TOP grant to support program activities and work towards the accomplishment of four outcomes:¹

1. Increase citizen participation in and understanding of the urban watershed, enabling community members to make significant contributions to improving the natural and social environment;
2. Facilitate greater civic engagement of the UC Berkeley campus in the surrounding community by developing and supporting ways campus faculty, students, and staff can share their work, knowledge and time;

¹ The four outcomes listed here differ from those articulated in the original 2003 project proposal. The outcomes were revised in the first year of the project to more accurately reflect the CW project's commitment to civic engagement of the university and the formal project goals. The changes do not substantially alter the program activities or outcomes of the project and are described in more detail in the "Evaluation Framework and Methodology."

3. Build a sustainable regional partnership of CW partners; and
4. Implement a web-based system for sharing watershed content—the Watershed Contribution Exchange—that becomes integrated into the on-going work of project partners.

Over past three years, CW partners have hosted and participated in numerous activities to achieve these outcomes and their efforts have been widely successful. CW partners led a variety of courses, workshops, restoration events and other programs for students, teachers, and other citizens. They participated in regional watershed conferences and UCB outreach workshops. They experimented with various technologies to facilitate information sharing among partners and created the Watershed Exchange, a web-based content sharing platform where partners can store and share documents and data, and communicate about schedules using an online calendar function. They developed a system for using Global Positioning System (GPS) units and the webGIS application Google Earth to collect and analyze spatial data in the classroom. In addition to these program activities, project partners developed the infrastructure to sustain the partnership and continue to use CW technological tools following the completion of the grant. CW partners and evaluators also identified the replicable elements of the program and disseminated information about these techniques and tools so that the lessons of the project extend beyond the direct participants.

Civic Engagement and City | *Watershed*

“The University of California is the nation’s largest and most prestigious public research institution. As such, we have an opportunity and a responsibility to assume a leadership role in an emerging national movement within higher education, translating our identity as a land grant institution into the 21st century terms”

- Promoting Civic Engagement at the University of California, 2005

The CW project’s core efforts are related to the reengagement of the civic mission of the University of California, Berkeley. The historic mission of many American universities is rooted in civic engagement, public purpose and the creation of stronger communities through university presence.² Land grant institutions, such as the University of California, Berkeley, were created by the Morrill Act of 1862, which stipulated a commitment to ‘service to society’ in its mission.³ Overtime, however, research universities have undergone a transformation away from service to a greater focus on pure research.

The last decade has brought a renewed interest in moving universities back into the public sphere through civic engagement. Across the country, “there is increasing interest in efforts to better prepare people for active citizenship in a diverse democracy, to develop knowledge

² Boyte, H., and Elizabeth Hollander. 1999. “Wingspread Declaration on Renewing the Civic Mission of the American Research University: The Wingspread Conference.” Racine, Wisconsin: Campus Compact; Checkoway, Barry. 2001. “Renewing the Civic Mission of the American Research University,” *Journal of Higher Education*, 72 (2). Gibson, Cynthia. 2006. “New Times Demand New Scholarship. Research Universities and Engaged Scholarship: A Leadership Agenda for Renewing the Civic Mission of Higher Education,” Tufts University and Campus Compact.

³ Gibson, 2006.

for the improvement of communities and society, and to think about and act upon the public dimensions of our educational work.”⁴ The University of California, Berkeley is part of this effort and has called for the university to play a larger role in rebuilding the civic mission of the university.⁵

In the Wingspread Declaration, scholars provided guiding ideas of what it means for the institution to be “filled with democratic spirit” and offered examples of what this looks like. Among the examples were the creation of long-term, sustainable partnerships with communities and K-12 schools, the promotion of public understanding of its work, and the creation of systems that facilitate knowledge sharing between the university and communities.

The CW project, with its focus on opening up the resources of the university to the community and creating a university-community partnership that empowers citizens to contribute solutions to the problems of the urban watershed, directly answers the call for civic engagement. CW’s investigation of how to use technology to share information among multiple partners contributes to a greater understanding of how to use technology to build stronger community-university partnerships and to share the research resources of the university.

In general, communities and universities both benefit from partnerships and the sharing of resources. “For the community, partnerships can provide needed consultation and technical assistance, provide a source of student assistance and faculty expertise, and establish durable linkages with a university whose intellectual and institutional resources can make genuine contributions to improving quality of life.”⁶ Universities benefit from the new perspectives provided by the community, student opportunities to learn from practice, faculty exposure to emerging research issues, and a general civic engagement.⁷ These benefits have played out in the CW project. CW partners also encountered some obstacles common to community-university partnerships. These positive experiences and obstacles were chronicled and analyzed, and led to recommendations regarding the nature of community-university partnerships. The lessons of the project will inform future campus-wide civic engagement efforts.

Evaluation Framework and Methodology

The evaluation team has worked with the CW project from the inception of the grant. At the early stages of the grant, the evaluation was formative; that is, the evaluation was focused on the process and the evaluation team members were active participants informing the ongoing evolution of the project. Throughout the grant, the evaluation team tracked the progress of the project as well as changes in priorities and project objectives. The evaluators

⁴ Boyte and Hollander, 1999.

⁵ Anderson, Jodi, John Aubrey Douglass, Alice Agogino, and Kathleen L. Komar. 2005. “Promoting Civic Engagement at the University of California: Recommendations from the Strategy Group on Civic and Academic Engagement.” Berkeley: Center for Studies in Higher Education. December 2005,

⁶ Checkoway 2001

⁷ Checkoway 2001; Furco 2001

provided quarterly feedback in documents and meetings that influenced the CW core management team's prioritization of activities. The final evaluation draws on this work and is meant to illuminate areas where the project achieved planned outcomes, shifts in project priorities and objectives, challenges to the project, and best practices and lessons learned that are applicable beyond the completion of this grant.

Evaluation Framework

The final evaluation is organized around four programmatic areas:

1. Participation and Understanding,
2. Partnerships,
3. Technology, and
4. Program Sustainability.

These four programmatic areas encompass six strategic objectives and associated measures of success developed through collaborative discussions and planning (Table 1):

1. Participation and Understanding
2. Campus Engagement
3. Regional Partnerships
4. Technology
5. National Model
6. Funding

The objectives address the procedural aspects of the project, achievement of final outcomes, and the future sustainability of the project.

Table 1: CW Programmatic Areas, Strategic Objectives, and Measures of Success

| Programmatic Areas | Objective | Measurement |
|---|--|--|
| 1. Participation and Understanding | 1.1 Community Participation Increase participation in partner programs | <ul style="list-style-type: none"> ▪ 1,000 community members participate in watershed programs ▪ Approximately 700 participants will demonstrate measurable increase in knowledge ▪ 2 New UWP Classes ▪ 4 UWP Teacher Training |
| | 1.2 Partner Connections Expand institutional connections of partner programs | <ul style="list-style-type: none"> ▪ 1 New UWP Partner ▪ 1-3 New ESPM 190 Partners |

| | | |
|---|---|--|
| 2. Community-Campus Partnerships | <p>2.1 Campus Engagement</p> <p>Characterize the types and nature of ideal relations with campus faculty, students and staff</p> <p>Increase faculty participation in CW</p> <p>Increase UCB student involvement in the community</p> <p>2.2 Regional Partnerships</p> <p>Characterize desired ‘sustainable regional partnership’</p> <p>Develop mechanisms to facilitate such partnerships</p> | <ul style="list-style-type: none"> ▪ Descriptive ▪ 20 Faculty participants ▪ 50 students in ESPM178 and other activities annually ▪ Descriptive ▪ Descriptive |
| 3. Technology | <p>3.1 Watershed Exchange</p> <p>Develop, pilot and maintain Watershed Exchange</p> <p>Integrate Watershed Exchange into partners’ work</p> <p>Develop Scholar’s Box</p> <p>3.2 Technology in Environmental Education</p> <p>Engage students in technology-mediated activities</p> <p>Develop, pilot, and maintain WebGIS system for environmental education</p> <p>3.3 Technology for Information Sharing and Communication</p> | <ul style="list-style-type: none"> ▪ Release of Versions 1 and 2 of the Exchange for partner use ▪ Descriptive ▪ Descriptive ▪ Release of Scholar’s Box in public domain ▪ Descriptive ▪ Release of WebGIS system for partner use ▪ Descriptive |

| | | |
|---------------------------------------|---|--|
| | <p>Identify digital technology to facilitate information sharing and communication (e.g., digital repositories, weblog, Flickr, WebGIS) and pilot use of technology in partner programs</p> <p>Document process of using technology to share information</p> <p>Define concept of digital collection and pilot use</p> | <ul style="list-style-type: none"> ▪ Descriptive ▪ Descriptive ▪ Descriptive ▪ 2-3 pilot collection |
| 4. Programmatic Sustainability | <p>4.1 National Model</p> <p>Complete strategy to track CW growth</p> <p>Identify replicable elements</p> <p>Disseminate best practices and success stories</p> <p>4.2 Sustainable Partnerships</p> <p>Develop strategy for continuation of partnership beyond the life of the TOP grant</p> <p>4.3 Funding</p> <p>Secure funding for continuation of partner programs and use of tools developed in TOP grant</p> | <ul style="list-style-type: none"> ▪ Descriptive ▪ Descriptive ▪ Publications ▪ Conference presentations ▪ Descriptive ▪ Descriptive |

The CW goals were originally articulated as a set of four outcomes: (1) Participation and Understanding, (2) Contribution, (3) Sustainable Regional Collaborations, and (4) System for Sharing City Watershed Content- the Watershed Contribution Exchange. During the planning year, CW partners added a fifth outcome- Campus Engagement, identified two additional measures for success- Sustainability and Funding, and determined that ‘Contribution’ is not measurably different from ‘Participation and Understanding.’ Each of the six objectives is associated with several quantitative and qualitative measures of success.

Methodology

The CW project utilizes a logic model evaluation strategy (Appendix A). During the planning stage of the grant, program leaders in the East Bay, San Francisco and on the UCB campus worked with the evaluation team to establish objectives and outcomes and link them to both quantitative and qualitative measures of success.

Throughout the grant, the evaluation team collected and analyzed several types of data, involved as many stakeholders as possible, and utilized a variety of evaluation tools. The data collected and analyzed includes:

- **Interviews:** The evaluation team conducted quarterly interviews with program coordinators and management to provide ongoing assessment of the coordinators' priorities and satisfaction with the CW project as well as the progress of the project. Other project partners were also interviewed to assess partner needs and satisfaction.
- **Site visits:** The evaluation team attended several classes each year at the Urban Watershed Project, a session of ESPM 178, special field trips, CW related events, and annual UWP student final presentations to assess the educational value of the project and student learning.
- **Document collection and review:** The evaluation team collected and reviewed organizational documents and student produced materials to identify changes in partner organizations and assess student learning.
- **Participant tracking:** The evaluation team collected attendance data for all CW related activities to track the number of students, teachers, and citizens involved in the program.
- **Surveys and questionnaires:** The evaluation team collected surveys and course evaluation data from the programs to assess student learning and satisfaction with the program.
- **Website and weblog monitoring:** The evaluation team monitored the program website and weblog to track program development and evaluate the usability of the program website.

Changes in the City | *Watershed* Project

The CW project experienced a range of changes, both in personnel and technology, throughout the course of the grant. The most dramatic and sad of these was the death of one of the primary partners during the summer of 2003. Professor Don Dahlsten, the CW Faculty Coordinator for UCB, passed away prior to the start of the grant. With his death, the project lost many of its original contacts with partner organizations as well as some of the infrastructure for faculty and student outreach that he created in the UCB College of Natural Resources. CW project responded by re-focusing their partnership and outreach efforts primarily on K-12 outreach and reconstructing the infrastructure for campus engagement.

The project also saw turnover in staffing for the technology development, in the San Francisco Unified School District (SFUSD) administration, and in the teacher partners for education programs. Early in the second grant year, the graduate student hired to develop the webGIS tool left the program because he received fellowship funding. Though the loss of his technical capacities slowed the development of the webGIS tools, CW partners were able to work with the tools as they were provided and eventually adopted an alternate system. In response to each of the school district and teacher changes, CW leveraged the success of their programs and past relationship to build strong relationships with the new staff.

Additionally, the CW project operated in a time of rapidly changing technology. During the grant period, new technologies emerged that stretch the imagination and have changed the playing field for technology integration. As CW partners worked to develop their own technical tools, easy-to-use, proprietary and open source services with the desired functionality became available elsewhere. Partners realized that the best strategy for technology was to experiment with many of these tools and develop a toolbox of programs that offer a range of easy-to-use tools for many purposes rather than trying to independently develop a single tool. CW faced all of these changes in personnel and technology with adaptability and flexibility, modifying their program activities and focus without compromising their original goals.

Project Evaluation

Program Area One: Participation and Understanding

CW sought to increase student, teacher and citizen participation in the watershed and understanding of watershed processes. Program activities were designed to increase the capacity and motivation of project participants to become more involved in their city and environment with the ultimate goal that participations will contribute solutions to the interrelated problems of the city and watershed.

CW project partners lead courses, restoration events, and other programs to increase community participation and understanding of the urban watershed. The partners placed a special emphasis on engaging urban youth in the watershed, developing programs for students and teachers. To extend the reach of their programs and connect more students and teachers to the watershed, CW has utilized a two-pronged approach that focuses on (1) expanding the institutional connections of partner programs and (2) increasing participation in partner programs to enhance community participation and understanding. To maximize student excitement and learning, CW partners used inquiry based learning tools and their education activities blended technology-based activities with low-tech activities, and outdoor field learning with indoor analysis.

1.1 Community Participation

Objectives

- Increase community participation in watershed activities and understanding of environmental processes (1,000 community members will participate in watershed education, survey, and/or restoration activities. Approximately 700 of these participants will achieve a measurable increase in knowledge and skills about the city watershed and digital technologies used to address environmental problems)
- Four teacher professional development events (50 teachers from San Francisco and Oakland schools will receive hands-on training in inquiry-based methods of teaching environmental science using local resources)

- Extend network of schools served by CW programs (one new UWP school partner, one additional Galileo class working with UWP, and one to three new ESPM 178 partners)

Results

- 1563 students participated in CW project activities: 55 UCB student mentors and 1508 K-12 students in San Francisco and the East Bay; Education activities were meaningful and increased understanding of watershed
- Three K-12 teachers trained in digital technology through CW training sessions
- CW East Bay Program coordinator led teacher training sessions at two summer teacher training institutes, training approximately 40 teachers in place-based inquiry learning techniques and submitted funding proposal for future teacher training institute
- School network extended:
 - San Francisco: four new schools partners for UWP and one additional weekly class with Galileo High School
 - East Bay: eight new schools partners for ESPM 178

Student Participation and Understanding

With over 1500 students participating in CW activities the project far exceeded their participation goals (Appendix B). Approximately 135 high school students participated in one- or two-time restoration or workshop activities and over 1,400 K-12 and UCB students participated in CW courses that met weekly for a period of four to nine months. Students engaged in the long-term CW programs demonstrated excitement about the urban watershed and increased understanding of environmental science concepts.

In the East Bay, UCB students participated in an environmental education course and taught environmental science modules in local K-12 classrooms during the school year. A total of forty UCB undergraduate and graduate students took ESPM 178A, a semester-long environmental education course taught by Dr. Mark Spencer during the CW grant term. Ten of them continued their work either through participation in ESPM 178B, a semester-long internship that builds on the work in ESPM 178A, or by leading a summer program for high school students. The annual course enrollment grew over the course of the grant from 12 students in the 2004-2005 academic year to 28 students in the 2005-2006 academic year.

The ESPM 178A and B students led environmental science workshops for over 1,300 K-12 students in the area. The increased annual enrolment in ESPM 178A and additional leadership of the ESPM 178B allowed Spencer to connect with a larger network of schools and reach more K-12 students. The number of partner K-12 schools jumped from three at the inception of the grant to 11 at the end of the grant, and the number of K-12 student participants increased from 231 in Spring 2005 to 610 in Spring 2006.

UCB student mentors also led environmental science modules in five summer programs, Academic Talent Development Program (ATDP), Central Valley Drift Catcher Program,

Early Academic Outreach Program (EAOP), Richmond After School Program, and Team Oakland.

UCB student mentors and their K-12 students learned concepts in environmental science. UCB mentors learned about biodiversity, the unique climatic conditions of the Bay Area, field sampling techniques, basic statistical tools for data analysis, and teaching techniques to help them translate these concepts into lessons and field activities for their K-12 students. One UCB student mentor commented:

This course has taught me so much about working in the field—I was a blank slate before this. I learned how to teach students in the outdoors and engage them in environmental issues (which may not always be exciting to them). I have also learned how to teach different types of students in a variety of different situations.

The process of creating lesson plans and teaching solidified the UCB students' expertise and the UCB student mentors demonstrated their mastery in their lessons.

Throughout their course, UCB student mentors were trained to use place-based inquiry learning techniques and created lesson plans with a field component. The exposure to the outdoors and hands-on component of the lessons made the experience meaningful and engaging for the K-12 students. Following their lessons, they reported that the K-12 students loved being outside and were engaged in the hands-on lessons. Describing the reaction of K-12 students to an environmental lesson, one UCB student mentor wrote:

When we asked them what their favorite part of the day was, most of them responded, 'the fresh air.' The field study was key to our lesson. The students were able to actually experience what we were teaching them and see how a concept like biodiversity can affect the landscape around them (and not some distant rainforest they will never see).

Another UCB student mentor wrote:

I believe that environmental education is key for all levels of students. It teaches us about the world around us, allowing us to think critically of the environment, both natural and urban. I think environmental education is unique in that it can be taught both inside and outside of the classroom and is a subject that can easily be crossed and connected to math, hard sciences, English, and real life; this means that there are many more ways to get a student excited about environmental science because it can really become a subject that makes learning fun.

The opportunity to be outside and connect to the environment as well as the use of lessons designed to engage students in hands-on learning were key to the success of the East Bay programs.

In San Francisco, over 200 high school students participated in the environmental education programs led by Mr. Doug Kern of the Urban Watershed Project (UWP) with the Crissy Field Center (CFC) at the Presidio National Park. CW supported Kern's efforts to work with the Crissy Field Center (CFC) and K-12 partners to double the number of Galileo Academy of Science and Technology students participating in weekly science courses and extend the reach of the program to new audiences. At the inception of the grant, UWP

hosted one weekly environmental science course for 18 students at the Galileo Academy of Science and Technology. By the completion of the grant, the UWP had expanded to two weekly environmental science courses serving 50 Galileo students. The UWP also developed modular one or two day courses for high school students and hosted 135 students from four new San Francisco high school partners.

The environmental education programs at the Presidio provide urban students the opportunity to learn about their watershed in an outdoor setting. UWP uses a combination of engaging lecture, experimentation, technology tools and outdoor exploration to involve students in their work. Students in the UWP programs learn about biodiversity, air and water quality, geology, and gain proficiency with a variety of technical tools. They also learn how to pose a question about their watershed and design a project or experiment to answer their questions. The students demonstrate the depth of their environmental and technical literacy and their command of the scientific method through public presentations of their final projects.

In addition to increasing the number of students benefiting from UWP programs, CW helped strengthen the UWP educational experience. In particular, participation in the CW project provided the funding and support necessary for Kern and his teaching partner at the Crissy Field Center, Ms. Charity Maybury, to review, improve and document their curriculum. CW also facilitated access to a WebGIS tool that allowed students to spatially view and analyze pictures and data. The adjusted curriculum and technological tools created opportunities for Galileo students to dig deeper into environmental problems. The depth of their learning experience was demonstrated by the increasing sophistication of final projects from year to year.

Teacher Participation and Understanding

CW carried out four teacher-training activities, reaching approximately 40 teachers. The original project goal was to reach 50 teachers over the course of three years. The initial goal was based on the assumption that the project would quickly develop web-based tools for use in inquiry-based learning, and that the teacher trainings would be instruction in the use of these tools. However, the technology development proceeded slower than planned and the organization of large CW teacher training sessions was delayed.

Though smaller than originally proposed, CW partners carried out two types of teacher training activities with two separate goals. First, CW partners sought to train large numbers of teachers in teaching methods they can use in their classrooms. Dr. Mark Spencer led teacher-training sessions at two summer teaching institutes, one hosted by the Headlands Institute and the other by Save the Bay. He trained teachers to use place-based inquiry learning techniques, a teaching methodology successfully used in East Bay environmental education program.

Many of the K-12 teachers at partner schools had limited experience with technology. The goal of the second type of teacher training was to train teachers to use technology so they can use the tools in their classroom and keep pace with their students who were learning these tools in CW programs. Mr. Doug Kern and Ms. Charity Maybury created a teacher-training module to develop teachers' competency using GPS devices, digital cameras, Google Earth and PowerPoint. Their partner teacher at Galileo, Ms. Lisa Franzen, completed the

training during a course field trip. Franzen became proficient in the technology her students were using in the UWP course. During the summer of 2006, Mr. Rick Jaffe also worked with Franzen and two Oakland High School partner teachers to train them in using the Watershed Contribution Exchange and other web-based technologies in their classroom. Jaffe and the teachers also experimented collaboratively with new technologies to understand how these might be successfully used in the classroom.

1.2 Partner Connections

Objectives

- Extend network of schools served by CW programs (one new UWP school partner, one additional Galileo class working with UWP, and one to three new ESPM 178 partners)
- Build institutional support for expansion of CW programs

Results

- School network extended:
 - San Francisco: four new schools partners for UWP and one additional weekly class with Galileo High School
 - East Bay: eight new school partners for ESPM 178
- Environmental education program institutionalized within College of Natural Resources
- UWP strengthened institutional connections to San Francisco Unified School District and other organizations working at the Presidio National Park

Partner Schools and Institutions

CW successfully enabled the primary partner organizations in the East Bay and San Francisco to increase the reach of their programs and build institutional support to sustain the extended networks.

Participation in the CW project provided the East Bay Program Coordinator, Dr. Mark Spencer, with the resources to align partners, prepare for collaboration, redesign the environmental education course, and network with administrators in the College of Natural Resources to win institutional support for the environmental education and outreach programs at UCB. The support from CNR resulted in the creation of a staff position for Spencer at UCB and several changes in the environmental education course (e.g., course designation was changed from an experimental course to a permanent course, frequency of course was increased from one semester per academic year to two, and a second semester internship component was added to the course). The changes in the course created more enrollment opportunities for UCB undergraduates and more opportunities to recruit new school partners. By the end of the grant, the number of partner K-12 schools jumped from three to eleven and the number of K-12 student participants increased from 231 in Spring 2005 to 570 in Spring 2006.

The San Francisco Program Coordinator, Mr. Doug Kern, worked with staff at the Crissy Field Center to recruit new school partners for the UWP environmental education program

and strengthen institutional connections with the SFUSD and other organizations associated with the Presidio. UWP grew from one to two weekly environmental science courses for students at the Galileo Academy of Science and Technology and created new one- or two-day environmental science workshops for students at four new partner schools (Gateway High School, Jefferson High School, University High School, and Cross Cultural Environmental Leadership (Xcel) Academy). CW also provided resources to help Kern institutionalize relations with UWP partners and facilitated meetings between Kern and several SFUSD administrators to expose them to his program. The SFUSD administrators offered strong support and provided consulting funds to support Kern's work as science advisor to Galileo students. Kern and CW evaluator Dr. Deborah McKoy also participated in the George Lucas Education Foundation panel on project-based learning in 2006. The panel provided exposure for the UWP and highlighted their connections to UCB.

Program Area Two: Community-Campus Partnerships

The CW project brings together a diverse set of university, community, and educational partners concerned with the urban watershed. At the onset of the program, the core management team recognized that the ability to engage urban residents in their watershed hinges on developing strong connections between these varied groups, the creation of a network for sharing information among the partners, and the development of a means to sustain these relationships beyond the duration of the TOP grant.

One of the primary goals of the project is thus to strengthen and extend the web of partnership, and to establish a sustainable model for on-going collaboration in the development and administration of environmental programs. In the spirit of technological innovation, CW partners endeavored to find technology-based methods to facilitate communication among a geographically distant and diverse set of partners.

Activities and strategic efforts in this programmatic area focused on creating stronger partnerships among CW partners and community organizations as well as increasing meaningful engagement of the UC Berkeley campus with community partners working in the San Francisco Bay watershed.

2.1 Campus Engagement

Objectives

- Characterize ideal types of student, faculty and staff engagement in CW project and community
- Increase student and faculty involvement in the community (40 students per year and 20 faculty over entire grant).

Results

- Students: Increased enrollment in environmental education course and associated work at East Bay K-12 schools (12 students in Spring 2005, 15 students in Fall 2005, and 21 students in Spring 2006); Institutionalization of infrastructure at UC Berkeley for continued involvement of students

- Faculty: Modest faculty participation (9 faculty participants); Identification of challenges for engaging faculty in community outreach and development of a strategy for successful and realistic faculty engagement in future projects
- Staff: Several presentations of CW material and learning to outreach staff on-campus; Began the process of understanding how staff can help use technology in community outreach

Student engagement

The CW project supports student engagement at UC Berkeley through environmental education courses taught by Dr. Mark Spencer. Undergraduate and graduate students in Spencer's course study the theory and practice of environmental education and use this background to create lessons that integrate their knowledge of local environmental issues with core concepts from the fields of environmental science and resource management. Their lessons often translate UCB faculty lectures and research materials into forms appropriate for K-12 student and incorporate the spatial mapping systems and technologies developed during the CW project (e.g., GPS, digital cameras, webGIS, online data repositories). The UCB student mentors then present their lessons to students at Bay Area K-12 schools.

CW project provided the resources to institutionalize such student outreach during and beyond the TOP grant. At the onset of the grant, Spencer was supported through a 50% FTE from the CW project and the environmental education course (ESPM 190) was considered an experimental course. Through meetings with College of Natural Resource administrators and demonstration of successful projects, the environmental education component of the CW project gained recognition as supporting the core goals of the UCB College of Natural Resources (CNR). With the support of the Associate Dean of Instruction, Professor Sally Fairfax, and CNR Dean Paul Ludden, the environmental education course was elevated from an experimental course offered occasionally (ESPM 190) to a permanent course offered every semester (ESPM 178A). A new course, ESPM 178B, was also created to allow students to continue their work in the community by earning course credit for environmental education internships. Additionally, Spencer was hired by CNR in January 2005 as the Academic Coordinator for the Environmental Leadership Opportunities Program (ELOP). In this position, Spencer teaches the undergraduate environmental education course and facilitates additional student outreach in the community.

The addition of an extra semester of ESPM 178A and the creation of ESPM 178B allowed the annual enrollment of UCB undergraduates in the environmental education course to double over the course of the grant (Appendix B). The increased undergraduate enrollment created the opportunity to partner with more Bay Area K-12 schools and extend the reach of students in the community. The changes in course designation and hiring of Spencer in CNR assure the continued participation of UCB students in community environmental education and the creation of new opportunities for student outreach in the community.

Faculty engagement

The CW project deeply engaged three UCB faculty members in environmental outreach work and/or partnerships with community organizations, and an additional six faculty

participated in the program with a one- or two-time contribution (i.e. contribution of lecture content to ESPM 178 or field trip with community partner) (Appendix C). Though this fell short of the project's goal of engaging 20 faculty members, project participants were pleased with the modest increase in faculty involvement in the project and the experience generated valuable lessons about engaging faculty in outreach work.

The CW project initially envisioned two types of faculty involvement: (1) the creation and sharing of CW related research through digital collections and (2) direct outreach or collaboration of faculty with CW community partners. The three faculty members who were deeply involved fell into the second category and included senior faculty members with a deep commitment to outreach (Professor Sally Fairfax) and staff of the project whose academic research has a strong applied component (Dr. Maggi Kelly and Dr. Deborah McKoy).

While there is recognized value in bringing the expertise of faculty members to the community, more extensive faculty outreach was hindered by a range of challenges. Many of these challenges are common to universities and a few are specific to the CW project. In general, there are few institutional incentives and rewards for university faculty to engage in the community. In meetings with CNR faculty, the East Bay Coordinator, Dr. Mark Spencer, found that faculty had little interest in working with the community. One relatively new faculty member mentioned that his mentor had discouraged him from participation in the community because it would not count towards tenure. The lack of interest stems from the politics of the university and a faculty reward system that prioritizes research over service. Community work offers few opportunities for publications and places demands on scarce resources (e.g., space and budget). For the CW project, the death of Professor Don Dahlsten shortly before the grant started compounded the general lack of institutional support. With the loss of Professor Dahlsten, CW project lost its most senior advocate for faculty outreach and devoted a substantial amount of time rebuilding Professor Dahlsten's relationship with CNR.

CW partners learned that faculty partnerships must be backed by extensive administrative support to generate the necessary support for the programs. Faculty engaged in applied research programs are good candidates for deep involvement with community partners because they may benefit from the experience. Other faculty may be able to participate in a less intense manner if they do not need to provide much additional effort. Future efforts by CW partners to engage faculty in community work will focus on building administrative support for the program to create incentives for participation and target faculty with applied work.

Staff engagement

University outreach is idiosyncratic in nature, fluctuating with state budgets and initiatives. Campus engagement is currently in an upswing at UCB. CW partners sought to improve the quality of UCB outreach efforts by disseminating best practices for the use of technology to other outreach staff on campus. Mr. David Greenbaum and Mr. Rick Jaffe, CW Project Director and Manager respectively, met with staff from multiple outreach groups (including the Center for Cities and Schools, Lawrence Hall of Science, Water Resource Center Archives, Berkeley Natural History Museum, Residential and Student Services Program's Office of Student Development, Service Learning Research Center, UC Berkeley Botanical

Garden, and others) to discuss how to extend watershed related outreach and how to best use technology to share the University resources with the community. They shared technology best practices with university staff through a presentation at the UC Berkeley Advising, Counseling and Mentoring Conference “Preconference on Social Networking and Online Communities” held at UCB in March 2006. Jaffe also participated in the UCB Graduate School of Education’s Principal Leadership Institute, the Community and Education Leadership Partnership; and both Greenbaum and Jaffe attended the Berkeley Educational Partnership Roundtable, a group of outreach program staff who meet every two months to share best practices and discuss how their programs fit in the campus goals for outreach (Appendix D). In all of these efforts, Greenbaum and Jaffe relayed CW lessons learned about the use of technology in teaching, learning and facilitating communication among groups. His networking and collaboration with outreach staff will improve the overall quality of outreach at UCB.

Community partner experience

The success of community-campus partnerships depends on both the quantity and quality of campus work with community partners. The UCB leadership of the CW project was concerned with ensuring that CW partnerships were effective and that community partners were satisfied with the partnership. Over the course of the grant, the evaluation team and CW management team identified many benefits that community organizations received by partnering with UCB. They also identified some of the challenges for effective partnerships and developed guidelines for positive community-campus relations.

The primary community partners of the CW project are the Urban Watershed Project (UWP), the Crissy Field Center (CFC), and K-12 schools in San Francisco and the East Bay. The UWP and CFC identified access to university technical resources, research and expertise as well as the prestige of working with UCB as the main benefits of working with the university. While they initially hoped for greater involvement of faculty and students in the San Francisco programs, it quickly became apparent that scheduling and transportation were large barriers to this kind of relationship. They were pleased with the open dialogue about expectations, satisfaction and credit that was facilitated by the evaluation team and project management. The K-12 schools benefited from having creative environmental science lessons and field activities with no extra work required by the teachers. In establishing the East Bay and San Francisco environmental education programs, Spencer and Kern are careful to minimize the additional work of classroom teachers. In ideal situations, the students or environmental educator is able to provide the lesson content and delivery while the classroom teacher is responsible for classroom control.

2.2 Local and Regional Partnerships

Objectives

- Characterize desired sustainable regional partnership
- Develop mechanisms to facilitate such partnerships
- Develop strategy to continue partnerships beyond duration of TOP grant

Results

- Developed two strong networks linked by CW core management team:
 - East Bay network: strengthened CNR environmental education program, increased network of partner schools, linked CNR environmental education course and outreach to other education and outreach programs on-campus, and connected UCB and K-12 students to local environmental organizations
 - San Francisco network: strengthened relations between UWP project and Crissy Field Center, Golden Gate National Parks Conservancy, National Park Service, Presidio Trust, San Francisco Unified School District (SFUSD), and UC Berkeley, and extended network of partner schools
- Developed connections across UCB campus and with local organizations concerned with the watershed
- Cross-bay partnerships were limited due to distance and transportation constraints
- Established weblog for local environmental groups to facilitate communication and document sharing

Local Networks: East Bay and San Francisco Partnerships

Both the East Bay and San Francisco Program coordinators worked independently and in tandem with the Project Manager to extend and strengthen their networks (Appendix E).

In the East Bay, the programmatic foci were the environmental education courses (ESPM 178A and B) and increasing local outreach opportunities in the UCB College of Natural Resources (CNR). The CW project supported the growth and development of a strong set of East Bay watershed education networks that now includes multiple on-campus units and programs at UCB, 13 K-12 schools and education programs, and five watershed organizations. These partnerships enabled the CW project to extend the network of schools served by the environmental education course, develop programmatic links to other education and outreach programs on campus (e.g., UCB students in Cal Teach and the Undergraduate Research Opportunities Program can enroll in ESPM 178A and B to satisfy requirements of their program), link to other student populations (e.g., starting in the Fall of 2006, Contra Costa Community college students in the National Science Foundation funded STEP program will participate in ESPM 178A and B), share the CW teaching philosophy and techniques with new audiences (e.g., teacher trainings with the Headlands Institute and Save the Bay), link UCB and high school student to local environmental organizations doing restoration activities (e.g., EarthTeam, Friends of Sausal Creek, and Urban Creeks Council), and establish partnerships to pursue future grants to extend CW work after the completion of the TOP grant (e.g., Lawrence Hall of Science, UC Botanical Garden and the Alameda County Office of Education).

CW work in San Francisco was concentrated on building a network of partners to strengthen and support the Urban Watershed Project (UWP). UWP is the central node of the San Francisco network and the network includes five K-12 schools, four nonprofit and government organizations working at the Presidio, the San Francisco Unified School Department (SFUSD), multiple units on-campus at UCB, and nine watershed organizations. The CW project helped to solidify the UWP's relationship with SFUSD, increase support from the Crissy Field Center and become better positioned with other organizations in the

Presidio. Additionally, CW provided Kern with the resources to extend the UWP education programs to four new K-12 schools. These partnerships allowed the CW project to reach more students and have placed the UWP in a better position for future fundraising to support the continuation of the program.

Watershed and cross-campus connections

In addition to building strong local networks, the CW project established connections with several watershed and outreach groups on and off campus. These connections are the foundation for future partnerships (Appendix E).

The CW Project Manager, Mr. Rick Jaffe, networked with a variety of environmental organizations and attended conferences and events about the San Francisco Bay watershed. Off-campus, Jaffe and Dr. Mark Spencer participated in the January 2005 conference “Conversations about Watersheds” hosted by the East Bay Watershed Center and the David R. Brower, Ronald V. Dellums Institute for Sustainable Policy Studies at Merritt College. Jaffe collaborated with Dr. Andrew Cohen of the San Francisco Estuary Institute on a video project with Oasis High School. On-campus, Jaffe networked with the Water Resources Center Archives, the UC Berkeley Botanical Garden, Berkeley Natural History Museum, Lawrence Hall of Science, and several on-campus groups focused on university outreach.

Regional partnerships

CW proposed to build a regional network of environmental and educational organizations in the San Francisco Bay watershed and to provide a forum for data collection and sharing between project partners. The CW project developed two very strong partner webs, built connections with many watershed groups on and off campus, and experimented with web-based technologies to facilitate inter-group communication. Several factors, including logistics, stakeholder changes, and changes in project scope, limited cross-bay collaboration.

With the passing of Professor Dahlsten, the CW project lost its primary connection to several of the community organizations. Rather than spending its early efforts pursuing these lost connections, the CW core management team intentionally devoted the majority of its resources to building on its strength, outreach to K-12 education groups, and used the remaining resources to establish connections with other on- and off-campus watershed groups and to develop an information sharing forum for these groups.

Though the East Bay and the San Francisco CW networks are very strong and both linked to UCB, their cross-pollination was limited to CW core member meetings. CW partners believed that information exchange across the bay and between East Bay and San Francisco students could be a positive experience and brainstormed ways to connect students in the East Bay to those in San Francisco. However, the perceived benefits of cross-bay collaboration and interaction were not compelling enough to drive the partners to overcome the logistical obstacles of coordinating across the San Francisco Bay and reconciling time constraints and scheduling difficulties.

Weblog

In order to find ways to facilitate regional partnerships and information sharing, the CW project experimented with web-based communication technology. Two weblogs were created, one for the CW core management and evaluation teams and the other for East Bay

environmental groups and administered by EarthTeam. Both weblogs were underutilized—participants did not post to the sites or check them frequently. The CW management and evaluation teams found it more convenient to communicate by phone or email. EarthTeam staff never became engaged with the tool. CW partners believe that weblogs can be a useful tool for facilitating partnerships but, in this case, the technology was not right for the group.

Program Area Three: Technology

The CW project utilizes an integrated suite of digital technologies to increase community involvement and understanding of the urban watershed. Project partners used the suite of technologies in two primary ways, to engage students in environmental education and to facilitate collaboration and information sharing between groups concerned with the urban watershed.

3.1 Watershed Contribution Exchange

Objectives

- Develop, pilot and maintain Watershed Contribution Exchange
- Integrate Watershed Contribution Exchange into partners' work
- Develop Scholar's Box, a web-based content management tool that allows the collection, manipulation, and reuse of digital content objects from multiple sources

Results

- Watershed Contribution Exchange Versions 1 and 2 developed and piloted by project partners
- Watershed Contribution Exchange is being used by the East Bay and San Francisco Program Coordinators and classroom teachers in both program areas
- Scholar's Box not fully developed, functionally replaced by suite of technical tools with desired capabilities

Watershed Contribution Exchange

The CW project developed and piloted the Watershed Contribution Exchange (The Exchange available at <http://citywatershed.migcom.com/>), a web-based platform for storing and sharing digital content about the city watershed. The Exchange consists of a document repository to store and share documents, datasets and other types of information, an online calendar, discussion thread, and notice board. The Exchange also has GIS mapping capabilities.⁸ The Exchange is organized around a group structure that allows users to designate online content as public or restricted to registered group members and maintains the confidentiality of documents and discussions.

⁸ Though the Exchange has a functioning webGIS interface, project partners prefer to use other free GIS tools in their classroom.

The Watershed Contribution Exchange was initially envisioned as a three layer web-based platform consisting of an XML based content architecture that would enable materials to be marked up, structured and made accessible to others; the Scholar's Box, a content management tool that would allow the collection, manipulation, and re-use of digital content objects from multiple sources; and a GIS lens for the primary data view. The Interactive University (IU) was responsible for developing these technologies. Around the mid-point of the grant, it became apparent that the challenge of independently developing the three layers of the Exchange in a rapidly changing technological environment was too great for the small staff at the IU. The fast pace of technological innovation dwarfed the efforts of the IU staff.

The CW project responded to the rapidly changes by shifting their technology strategy. In addition to investing resources in software development, they became experts in locating and combining existing technologies to serve their needs. They contracted the development of the user-interface for the Exchange to a local consulting firm, MIG, Inc. In collaboration with MIG, the Exchange became a web-based data collection and sharing environment powered by Townsquare, a commercially available package of tools. Version 1 of the Exchange was released in September 2005 and piloted by the Urban Watershed Project environmental education program during the 2005-2006 academic school year. The CW Project Manager, Mr. Rick Jaffe, worked with the East Bay and San Francisco coordinators, and environmental science teachers Ms. Katie Noonan (Oakland High School), Mr. Kevin Jordan (Oakland High School), and Ms. Lisa Franzen (Galileo Academy of Science and Technology) over the summer of 2006 to evaluate Version 1 and suggest improvements for the next version. Version 2 of the Watershed Exchange was released in September 2006 and will be used by both the East Bay and San Francisco partners in the 2006-2007 academic year.

The Watershed Contribution Exchange in Partner's Work

The Watershed Contribution Exchange has been well received by the environmental education project partners and incorporated into their work.

Mr. Doug Kern, the San Francisco Program Coordinator, first piloted Version 1 of the Exchange with the environmental science class from Galileo during the 2005-2006 academic year. Kern found the calendar function and document repository to be the most helpful tools. He marked each week's session on the calendar, uploaded lesson plans and other related documents, and linked the two together. The calendar and documents were available to Ms. Lisa Franzen and Ms. Charity Maybury, his partner teachers at Galileo Academy of Science and Technology and the Crissy Field Center respectively. The linked schedule and lesson plans facilitated better communication and planning with the partner teachers. Additionally, the process of scheduling and uploading documentation led to better organization for the UWP and the ability to look holistically at their scheduled year and curriculum. Kern, Franzen and Maybury plan to continue using the Exchange in the 2006-2007 academic year.

The CW Project Manager, Mr. Rick Jaffe, worked with Oakland and San Francisco high school teachers during the summer of 2006 to train them to use the Exchange and further evaluate its functionality. All three teachers were grateful to increase their computer literacy and hopeful that the tools could increase the effectiveness of their teaching. Galileo teacher Ms. Lisa Franzen noted:

Last year, I encountered several web/tech related problems that I am very interested in resolving. It is my hope that by learning new skills and ways to access the web, I will be making both my job easier and giving my students the tools to help them learn better.

Oakland High School teacher, Ms. Katie Noonan commented:

I am very pleased with what we have accomplished and plan to work with it throughout the year ... I think this has made a real improvement in my teaching.

The Oakland teachers were especially excited to utilize the document repository function of the Exchange and will be using it to store and update water quality data throughout the 2006-2007 academic year. They created an Excel datasheet that is stored in the Exchange library. Students in their class will update the datasheet with new water quality each week. The data is available to all students in their class from any web location. Noonan feels that this functionality formalizes and organizes the data collection and entry process, and will help her students to be more diligent and careful in their data collection.

Overall, the Exchange has been well received by the environmental education project partners. They have worked with Jaffe to develop the Exchange so that it can satisfy their document and information sharing needs. In all cases, the online tools have helped to formalize and organize the project programs and made data sharing more organized and easier than before.

Scholar's Box and Technological Toolbox

The CW project began with the broad goal of producing a new tool, the Scholar's Box. The Scholar's Box was conceived as a web-based content management tool that would allow the collection, manipulation, and reuse of digital content objects from multiple sources. As the project advanced it became clear that technological innovation outside of the university was occurring at a rapid rate and that the IU did not have the staff capacity or resources to keep pace.

To build a set of tools with the functionality of the Scholar's Box, CW utilized a new technology strategy. Rather than solely continuing their effort to develop the Scholar's Box, they also identified existing technological tools and experimented with them to determine how to effectively use them together. The group of tools is known as the Technological Toolbox and described in Programmatic Area 3.3 "Technology for Information Sharing and Communication".

3.2 Technology in Environmental Education

Objectives

- Engage students in watershed through technology-mediated activities
- Develop, pilot, and maintain WebGIS system for environmental education

Results

- Students in both program regions participated in technology-mediated programs and developed skills in basic computer communication software, webGIS, Google Earth, PDA and GPS units, digital cameras, video editing technology, and water and air quality sampling equipment
- Developed practical and successful webGIS system for use in environmental education programs
- Identified suite of technologies appropriate for education and integrated technologies into Technological Toolbox

Technology-mediated activities for environmental education

CW partners developed technology mediated watershed activities for students and teachers in San Francisco and the East Bay. Student participants combined interpretive and mobile technologies (e.g. PDA, GPS units, digital cameras, air and water quality sampling tools) with desktop technologies (e.g. Google Earth, webGIS, Microsoft Excel, PowerPoint, video editing software) to collect, analyze, and communicate information about the San Francisco Bay watershed.

In San Francisco, Mr. Doug Kern led students from five area high schools in watershed activities that utilized multiple technological tools. Students from Gateway, Jefferson, University and XCEL high schools attended one or two watershed events hosted by UWP. In these events, students used a full suite of water quality testing equipment, GPS units, Google Earth, and Excel to test water quality at a restoration site. Students from Honors Environmental Science courses at Galileo Academy of Science and Technology visited the Presidio every week for a lesson and lab during the academic years. Through activities such as a CyberTracker watershed scavenger hunt, geologic tour of the Presidio, plant identification, stream bioassessment, and air quality monitoring, Galileo students became proficient in the use of PDAs, GPS units, digital cameras, webGIS, Microsoft office suite, water and air quality sampling equipment, and, beginning in September 2005, Google Earth. Students found these tools, particularly the combination of GPS units, digital photography, and Google Earth, very engaging. In a 2004-2005 mid-course review, Galileo students identified the CyberTracker scavenger hunt as one of their favorite program activities.

In their final quarter, teams of Galileo students also undertook independent research projects in which they used the scientific method to investigate some aspect of the watershed and presented their findings at a public event. In the 2005-2006 academic year, every project team designed a project that used technologies learned in the course. Through these projects, Galileo students demonstrated their understanding of the technology for data collection, analysis and presentation and ability to apply the technologies learned earlier in the course to new research questions.

Additionally, six environmental science students from Galileo Academy of Science and Technology created and facilitated a workshop for their peers on using GPS devices, digital cameras and Google Earth at the 2006 Youth Quest conference. Their workshop consisted of a self-produced video introduction and live instruction. The students were supported by staff but did the majority of the workshop planning on their own.

In the East Bay, K-12 and UCB students use technology in classroom activities led by UCB students in ESPM 178A & B, summer programs facilitated by UCB students, and restoration projects carried out in conjunction with local environmental non-profits. High school students participating in classes led by ESPM 178A&B students used technologies such as GPS units, digital cameras, webGIS tools, and air and water quality sampling tools during the 2004-2005 and 2005-2006 academic years. Eighty students from Team Oakland participated in a four-week summer session where they learned to use spatial technology, developing skills in the use of GPS units, digital cameras, geocoding, and webGIS. Students participating in restoration activities with non-profit partners (Friends of Sausal Creek and Earth Team) recorded their efforts with digital cameras and geocoded the location of their work and photos using GPS units. Students from Oasis High School participated in a videotaped session on invasive species led by a local environmental non-profit (SFEI). Finally, in the summer of 2006, CW partnered with the Pesticide Action Network North America (PANNA) to facilitate a pilot “Drift Catcher” program for high school students from the Central Valley. The pilot program merged technology tools tested in CW with the drift catcher, a simple air quality device created by PANNA to detect pesticide drift. Two UCB student mentors led five high school students from the Central Valley in activities that integrated the drift catcher, GIS, gas chromatography, basic chemistry, and advocacy.

In both San Francisco and the East Bay, project partners recognized the need to educate not only students but also their teachers in the use of technology. The partner teacher at Galileo Academy of Science and Technology, Ms. Lisa Franzen, learned to use the GPS units and Google Earth in a training activity. She has also been trained to use tools in the Watershed Contribution Exchange. Two teachers from Oakland High School, Ms. Katie Noonan and Mr. Kevin Jordan, were also trained to use tools in the Watershed Contribution Exchange so they can effectively utilize these technologies in their classrooms. Following the training and summer work with the technology, Noonan noted:

As school starts, I am pleased with the new tools I have acquired. The work I have done with Rick has had unexpected spin-offs. I have made considerable use of Flickr and links to share pictures within the academy. The site has also attracted the attention of researchers interested in plankton. The work has provided impetus to get together the needed hardware in my room. I have more confidence that I can incorporate technology into my lessons.

Finally, experimenting with the use of technology in environmental education classrooms provided project partners with the experience necessary to evaluate their effectiveness as educational tools. They found that the geospatial tools were particularly effective in the classroom—students liked using them, learned new and marketable skills, and were able to gain a new level of understanding of the relationship of data. San Francisco Program Coordinator, Mr. Doug Kern, critically examined the use to technology in his curriculum and continues to experiment with new technologies in the classroom. His goal is to use technology to enhance the educational experience rather than to rely on technology as an end in itself. In the 2006-2007 academic year, Kern will use iPods and PodCasts to deliver short lectures that can be listened to either in the field or out of the classroom. For his environmental education work, he notes that

[A big] advantage of the iPod : it's a cool thing.

Technology can bring “coolness” to a lesson, generate excitement, increase the data collection and analysis of students, and provide alternate means for explaining difficult concepts. Throughout the course of the grant, Kern identified lessons and topics that benefit from the use technology as a teaching tool and also identified lessons where these tools are unnecessary or distracting. UCB student mentors in ESPM 178 A and B made similar evaluations when designing their lessons and curriculum.

WebGIS/Google Earth

CW partners sought to develop a webGIS system that would allow students to upload and analyze geo-coded field data in a single classroom session. In the 2005-2006 academic year, the project successfully piloted the coordinated use of GPS units, Google Earth and other technologies to realize this goal.

The path to this successful system was full of experimentation and, at times, was frustrating for the partners. In 2004, CW first implemented an innovative but rudimentary system to use a webGIS data-sharing program in the UWP-Galileo environmental science program. The San Francisco Program Coordinator, Mr. Doug Kern immediately recognized the potential of using PDAs, GPS units, digital cameras, and webGIS in his classroom. However, in early test versions, the process for uploading the field data onto the GIS platform was cumbersome and slow, making the system impractical for the classroom. Students had no way to gather data and upload it in the same class period. By the time the data was uploaded by someone else, the class had moved on to a new topic and experiment. The lack of continuity in the students’ experience with data collection and analysis left the tool underutilized.

The CW project prioritized the development of a functional webGIS system for the classroom. The development process was hindered by changes in the webGIS staff and communication and scheduling difficulties between San Francisco partners and the technology staff at UCB. The project eventually moved from technology development to identification and consolidation of appropriate technologies. CW partners identified two workable WebGIS paths: Google Earth and the XML-based BerkeleyMapper.

Towards the end of the 2004-2005 academic year, Google made a version of Google Earth with all the desired webGIS functionally publicly available at no cost. Mr. Rob Weinberg, the technologist in the Crissy Field Center Media Lab, devised a set of mapping activities for the classroom using Google Earth. These proved to be engaging to students. During the first weeks of the school year, students mapped their orientation treks through the park. Later in the semester, the students plotted seismic activity data from a US Geologic Survey web site to Google Earth, where they could easily relate an earthquake to its geographic surroundings and to the edges of the nearest tectonic plates. The project partners spent the summer experimenting with the program and Kern focused on identifying lessons in his curriculum that would benefit from a spatial tool.

The identification of a successful webGIS system has been pivotal in the success of the grant and the partners perception of grant success. Kern reflected that with this system, his students (2005-2006 academic year) are finally utilizing and benefiting from technology. With the combined use of TownSquare and Google Earth, the students are able to analyze

and display data in the same class period and have jumped from data collectors to data analyzers, drawing conclusions and making inferences from their data.

Concurrent with CW's implementation of Google Earth, project staff also began experimenting with BerkeleyMapper, an XML-based mapping tool made available freely by a unit on the UC Berkeley campus. BerkeleyMapper takes a data set and a configuration file, the server locations of which are passed to it as elements of its url, and presents the data on a Google map interface. This tool allows the user to select which field of the data set to display as labels and provides a second webGIS option for partners.

3.3 Technology for Information Sharing and Communication

Objectives

- Identify digital technology (e.g., digital repositories, Flickr, WebGIS, weblog) to facilitate information sharing and communication and pilot use in partner programs
- Document process of using technology to share information
- Define concept of digital collection and develop 2-3 pilot collections

Results

- Identified and piloted the Technological Toolbox, a suite of technologies for sharing information and enhancing environmental education
- Created lesson plans that document use of Technological Toolbox and Watershed Exchange
- Additional online documentation of Technological Toolbox will be released in November 2006
- Created working definition of collections and one pilot collection

The Technological Toolbox—

Digital technologies for information sharing in partnerships and education

CW partners and participants have experimented with a variety of web-based tools and other technologies to facilitate information sharing and communication between partners.

The technologies include:

- **Project management tools and digital repositories:** Galileo and Oakland High School teachers, the Urban Watershed Project, and the CW management team use the Watershed Contribution Exchange powered by Townsquare to store information (e.g., class schedules, lesson plans, geospatial data, management documents) and make it available to others. The Urban Watershed Project also utilizes Strong Space, a web filing system, and iCal, an calendar program with RSS feed. The Interactive University has also experimented with two other web-based project management tools, bSpace, UC Berkeley's implementation of the SAKAI 'community-source' course management platform, and Basecamp, to share documents and messages. As described in an earlier section, the Exchange has been well-used by project partners.

- **Photo collections:** Oakland High School teachers and partners at the Presidio use Flickr, a commercial web-based photo sharing service, to store and share photos. OHS teachers have posted pictures from student field trips and photos of experiments. Partners at the Presidio have uploaded more than 1500 photos of plants present in the Presidio. Flickr provides a convenient way to store and share photos.
- **Weblog:** The CW management team hosted a weblog on the Interactive University Manila system. CW also established a weblog administered by EarthTeam and hosted by Manila to link environmental non-profit partners. Neither of these weblogs received much use.
- **WebGIS:** CW partners have made extensive use of webGIS programs and have experimented with four different platforms. The CityWatershedMapper was the initial attempt at developing an appropriate GIS system and took two forms, one powered by ESRI, a proprietary set of software tools, and one by MapServer, an open-source webGIS platform. Both are powerful analytical systems whose sophistication make them too clunky to be well utilized by partners. The other two webGIS systems were experimented with concurrently—Google Earth is used in the UWP environmental education program and the Project Manager has experimented with BerkeleyMapper, an XML-based GIS environment. Both webGIS programs make posting and analyzing data quick and easy.
- **Video and digital cameras:** All partners have made use of video and still photography to document data collection and create effective presentations about their activities and findings.
- **iPods and Podcasts:** CW San Francisco Program Coordinator, Mr. Doug Kern, experimented with iPods as teaching tools during the summer 2006. Kern plans to pilot the use of iPods in the classroom during the 2006-2007 academic year with environmental science students from Galileo Academy of Science and Technology.

CW partners discovered that the distributed capabilities of a variety of technologies add up to a useful suite of tools with range, flexibility and power that is greater than any single application. Through experimentation with these tools, each CW partner has found a package and subset of tools that complements their program.

Documentation of the Technological Toolbox

Applications of the various components of Technological Toolbox will be documented through lesson plans (Appendix F) that utilize the tools and a web-based narrative describing the process of identifying the tools and their potential uses. Teachers who participated in CW technology training during the summer 2006 created the lesson plans that describe an environmental science lesson utilizing at least one component of the Technological Toolbox and provides detailed instructions regarding the use of that technology.

The CW Project Manager, Mr. Rick Jaffe, is creating an online narrative describing the range of technologies available for the classroom and collaborative efforts. The documentation is scheduled to be available online in November 2006 and will provide descriptions of the tools, examples of innovated applications, and instructions for accessing the tools.

Digital Collection

CW sought to create themed digital collections to share UCB research and resources with internet users. Themed digital collections consist of materials from institutional libraries and other large collections, as well as objects gathered through research and teaching, that are organized thematically, may be annotated as to their meaning, and stored locally. CW partners hoped that the creation and dissemination of digital collections would make UCB research and resources better available to the public, engage faculty in the community, and facilitate civic engagement goals of UCB.

CW originally anticipated that the collections would be driven by faculty and be grouped around faculty research areas. However, CW partners discovered that developing systems for gathering, organizing, and sharing the digital content and other information gathered from students' (or other group members') investigations were more important to their project-based education efforts than large formal collections from experts. The project thus shifted its focus from developing collections of faculty-driven content to helping users manage and benefit from student and other user-driven collections.

CW created one digital collection, a Flickr-based photo collection of Presidio plants, that was a hybrid of expert/user driven collection. San Francisco Program Coordinator, Doug Kern, compiled over 1500 images of plants in the Presidio gathered from his colleagues working at the Presidio National Park. This collection makes these images more accessible to staff at the Presidio and the general public.

Program Area Four: Sustainability

CW project partners believe that a successful project hinges on the long-term sustainability of the partnership and programs developed through the TOP grant. Sustainability depends on the development of infrastructure to support the continued use of the technological tools developed during the grant and the continuance of CW partnerships.

Additionally, CW responds to a national call for increased civic engagement of universities and the need to understand how to use technology to facilitate civic engagement and other collaborations. Partners thus believe that the program sustainability also depends on the dissemination of best practices and lessons learned during the project so they can be applied by others.

CW took a three-pronged approach to ensure the long-term sustainability of the project: (1) the identification and dissemination of best practices that will allow the lessons of the project to be used by other organizations, (2) establishment of a model for sustainable partnerships that will lead to on-going collaboration and the continuation of project programs and activities, and (3) securing funding to support spin-off efforts that continue and extend the work begun in the CW project.

4.1 National Model

Objectives

- Complete strategy to track CW growth
- Identify replicable elements and best practices
- Disseminate best practices and success stories

Results

- Evaluation team tracked growth of CW
- Identified best practices for civic engagement of research universities, partnerships, and the use of technology for information sharing and in education
- Disseminated best practices and lessons learned at national conferences, on-campus presentations, participation in campus outreach roundtables, and summer teacher training programs

CW growth

The CW Evaluation Team documented the increases in participation, partner connections, and links to other organizations in order to track the growth of the project.

Replicable elements and best practices

CW partners sought to identify the areas of their project that were unique as well as those that can inform other programs and form the base of a national model for using technology in education and collaboration. In this vein, CW partners worked to identify best practices in three areas: civic engagement, partnerships, and technology. For each of these areas, partners and evaluators identified a set of best practices and lessons learned to inform other projects and their own future work. The general lessons learned are described in the following section, “Best Practices and Lessons Learned”. Partners also identified specific technologies that function well for different situations. Documentation will be available online in November 2006.

Dissemination of best practice and lessons learned

CW partners disseminated the lessons learned and best practices of the CW project in three primary venues:

- **National conference presentations:** San Francisco Program Coordinator, Mr. Doug Kern collaborated with UC Berkeley Professor William Berry to present at the 2004 and 2005 annual Geological Society of America meetings. In 2005, they participated in the Geoscience Education Panel, giving a talk entitled “Bringing Innovation and Relevance to Environmental Science Education in a National Park.” In this talk, they described the Galileo-Urban Watershed Project environmental science program with a focus on the innovative use of GPS/PDA and Google Earth to analyze spatial data. In 2004, the pair presented a talk entitled “Teaching Watershed Processes in the Presidio, an Urban National Park” in the session “Innovative Approaches to Teaching ‘Geology of National Parks’: Tales from the Classroom, Field, Page, Web, and Beyond.” In this talk, they described the use of the Presidio as an outdoor learning classroom.
- **On-campus presentations:** In the final year of the program, Project Manager, Mr. Rick Jaffe, and Project Director, David Greenbaum have investigated ways to extend

the technology honed through the CW project to other audiences. In 2006, Jaffe gave a series of presentations about the applicability of these tools in education and outreach. His audiences included the Principal Leadership Institute at the UC Berkeley Graduate School of Education, the Center for Cities and Schools' Community and Education Leadership Partnership, and the Academic Pathways office of the San Francisco Unified School District. Similarly, Jaffe and Greenbaum made presentations to student affairs/student life groups at UC Berkeley, the Berkeley Educational Partnership Roundtable, and to the 15th Annual UCB Advising, Counseling and Mentoring Conference (which draws student development professionals from around Northern California). In these presentations, Jaffe and Greenbaum describe how CW has used web-based tools in teaching and learning, and discuss how these tools can aid collaborative work more generally.

- **Teacher training:** East Bay Program Coordinator, Dr. Mark Spencer, was an instructor in teacher training institutes with Save the Bay and the Headlands Institute in the summer of 2005. His training modules focused on inquiry-based learning methods for environmental education, techniques taught in ESPM 178 and used in CW associated K-12 outreach. Additionally, Spencer has partnered with the Lawrence Hall of Science, UC Botanical Garden, and the Alameda County Office of Education to apply for NSF funding for an in-service teacher-training program that would further disseminate these techniques.

4.2 Sustainable Partnerships

Objectives

- Develop strategy for the continuation of partnerships beyond the life of the TOP grant

Results

- Strengthened institutional connections and relations of CW partners to ensure lasting relations and partnerships

Sustainable partnerships

The long-term strategy to build sustainable partnerships focused on the development of strong local programs and partnerships with K-12 schools.⁹ CW partners focused on extending their networks of partner schools and strengthening their institutional connections. The CW project succeeded on both counts in both locations, the East Bay and San Francisco. The institutionalization of CW partner projects facilitates the long-term continuation of their programs and helps to guarantee future funding.

⁹ At the inception of the grant, CW partners planned to build a strong regional network of organizations working on issues related to the urban watershed. They wanted to develop a model for communication and information sharing that would be sustained beyond the completion of the grant. With the loss of PI Professor Don Dahlsten and the refocusing of the project on K-12 partners (rather than watershed non-profits who might benefit from sharing information), the goals for the partnership also changed. CW core partners focused on strengthening and extending the local environmental education programs in the East Bay and San Francisco rather than developing a regional partnership across the San Francisco Bay.

As described in the Programmatic Area 1.2 “Partner Connections”, the UWP expanded its relationship with the Galileo Academy of Science and Technology, connecting with a new teacher and adding a second class, and also developed partnerships with four additional schools. The formalization of institutional ties with the San Francisco Unified School District, the Crissy Field Center, and UC Berkeley support this growth and help to ensure that it will continue in the future.

In the East Bay, the Dr. Mark Spencer expanded the network of partner schools, developed strong ties to the College of Natural Resources (CNR), and institutionalized the CNR environmental education outreach program. The environmental education course was formalized as part of the CNR standard course offerings and Spencer created a companion internship course. In his new position with CNR, Spencer has initiated new partnerships and outreach programs on and off campus. New ties to the Cal Teach initiative and STEP Environmental Leadership Pathway provide resources to continue the environmental education outreach.

4.3 Funding

Objectives

- Secure funding for the continuation of CW partnerships and activities

Results

- Received funding from federal and private grants for partners to continue CW activities and the use of tools developed during the grant.

Future Funding

The core CW partners secured additional funding to continue project activities, use the technology tools and apply best practices in their work.

Throughout the program, partners examined the goals of their individual organizations and the potential for collaboration and applied for various sources of funding to continue their work and partnerships. The connections made through CW and institutionalization of the partner’s programs laid the foundation for securing additional support for the continuation of CW activities. In San Francisco, Kern formalized his relationship with the San Francisco Unified School District and they have funded him as a consulting science advisor to support his work with San Francisco high school students. In the East Bay, Spencer was hired by the College of Natural Resources to continue teaching ESPM 178A&B and to direct the Environmental Leadership Opportunities Program (ELOP), a CNR outreach program. Additionally, Spencer linked his work to other education outreach programs on campus to increase enrollment and support for ESPM 178A and B. Starting in the Fall 2006, students enrolled in the Cal Teach initiative to develop science teachers will enroll in ESPM 178 A and B to fulfill program requirements. This program provides stipends to both the Cal Teach students and their host classroom teachers. These institutional links ensure that the programs can continue their educational activities and continue to engage new students in the environment.

Additionally, the primary project partners received three grants that build on the work of the CW project:

- **NOAA California Bay Watershed Education and Training (B-WET):** The B-WET program administered by the National Oceanic and Atmospheric Association (NOAA) provides funds to support environment-based education programs in California watersheds. The Urban Watershed Project together with the Crissy Field Center received \$49,920 per year, renewable for two additional years, to fund their environmental education program with Galileo Academy for Science and Technology. This program will support the continued use of technology in the classroom, including the Watershed Exchange, GPS units, Google Earth, basic software, video and still photography equipment, video editing software, and air and water quality testing tools.
- **Science Technology Engineering Mathematics Talent Expansion Program (STEP):** The Environmental Leadership Opportunities Program, an outreach program administered by Spencer, received a 5-year, \$1.96 million STEP grant from the National Science Foundation. The grant funds a program called the Environmental Leadership Pathway that will engage 25 students from Contra Costa College in the ESPM 178 course series each year for five years. The STEP grant builds on the foundation of experiential learning, civic engagement, and continues to expand the environmental education outreach and CW work in the East Bay.
- **Shaw Fund:** UC Berkeley and the Presidio Trust received a grant from the Shaw Fund to design and launch the Presidio Archaeology Education Program. The Interactive University is one of several UC Berkeley programs participating in the project, which aims to use the Presidio as a learning laboratory for history, archeology and natural heritage. The Urban Watershed Project will also be continuing their partnership with UC Berkeley through this program. This program offers the potential to build on partnerships created through the CW project and to use CW technological tools to support the new education initiative.

Best Practices and Lessons Learned

The core partners and evaluation team of the CW project identified best practices and lessons learned in three areas: civic engagement, partnerships, and technology. These best practices and lessons learned should guide future programs by project partners and other groups outside of the project.

Civic Engagement

Recognize the opportunities and constraints of university system

- Universities have many resources that may be useful to community groups but are often limited in their ability to share them
- Examine the motivations, incentive structure and demands on various actors in the university system to identify promising and realistic partnership opportunities

Reward faculty and students for work in the community

- Students who receive credit for their work are accountable for their participation and have an incentive to overcome the obstacles of scheduling and travel to work off-campus
- Faculty work in the community is possible if they can be rewarded for their contribution (e.g., publications, grant money, department service credit)
- Faculty rewards for community work and publication opportunities may exist in applied departments (e.g., City and Regional Planning, Landscape Architecture, Education)
- Conversations with faculty may reveal hidden benefits of working with community

Cultivate administrative support for campus outreach programs

- Support and collaboration of administration legitimizes outreach work, can lead to credit for faculty participation, and minimizes political problems associated with struggles to access limited resources

Develop positive relations with community partners

- Create non-hierarchical relationship where the university is not the sole driver of ideas or practice
- Understand why community and university participants are involved and ensuring that the relationship is mutually beneficial
- Identify and make explicit the 'win-win' aspects of the partnership
- Respond to the community partner's needs
- Respect the busy schedules of community partners and minimizing any additional work requirements
- Maintain clarity about scheduling, expectations, and the distribution of credit for work

Partnerships

Partnerships must be meaningful and productive

- Goals and mutual benefits must be identified early
- Objectives and responsibility of all partners must be clear
- Must have understanding and awareness of each other's work
- Must respect the different political histories and needs of all partners
- Each partner needs to retain individual identity while also building a unique group identity

Successful partnerships depend on good logistics

- Organization, communication, and scheduling are key to mitigating the difficulties of conflicting schedules and dealing with the varying timelines for funding, school years, community organization, etc.
- Web-based communication technologies hold promise for facilitating better communication but are only successful if convenient and used regularly by all partners

Technology

Technology should be considered a tool

- Technology can be a valuable tool in education programs and to facilitate communication and data sharing but should not be used simply for technology's sake
- In the classroom, it is important to blend technology-based activities with non-technical experiences
- Technology cannot always substitute for face-to-face communication

Address technology learning curve

- There is a gradient of technology familiarity and comfort among users. For example, students tend to learn and adopt new technologies relatively quickly while teachers may not be accustomed to using technology and may not be as familiar with tools
- Must be sensitive to the different comfort-levels of different users
- Should develop different training programs for users with different technology familiarity

Consider the psychology of online communities

- Many people do not naturally use technology in daily life, for communication or jobs
- Consideration of the standard practices of potential users can help predict the likelihood that users will adopt technology
- Creation of online communities must consider the standard practices of users
- Web-based tools should be tailored to the particular needs and social norms of users

Use appropriate technology develop strategy

- Two basic motivations for developing technical tools:
 1. Problem-solving: identified need that a technological tool could address
 2. Innovation: desire to explore the promise of creative new tools
- Each motivation is associated with a different strategy for developing technology:
 1. Problem-solving strategy is likely to be directed and require persistence on part of participants
 2. Innovation strategy requires creativity and flexibility to experiment with new ideas
- Motivation, strategy and the needs of participants in technology development efforts should be aligned

Evaluation Summary and Conclusions

The City | *Watershed* Project sought to use technology mediated activities to engage citizens in the San Francisco Bay watershed and increase their understanding of the urban watershed.

They sought to achieve four primary outcomes:

1. Increase citizen participation in and understanding of the urban watershed, enabling community members to make significant contributions to improving the natural and social environment;
2. Facilitate greater civic engagement of the UC Berkeley campus in the surrounding community by developing and supporting ways campus faculty, students, and staff can share their work, knowledge and time;
3. Build a sustainable regional partnership of CW partners; and

4. Implement a web-based system for sharing watershed content—the Watershed Contribution Exchange—that becomes integrated into the on-going work of project partners.

CW found success in all outcome areas. CW partners engaged over 1,500 students in environmental education and restoration activities in the San Francisco Bay watershed. They established and institutionalized programs for UCB students to be involved in the community, identified new strategies for involving faculty, and networked with other outreach staff on campus. CW partners built strong networks of education and environmental partners and institutionalized their programs with their host and partner organizations. They successfully identified and experimented with numerous technologies for use in the classroom or as tools for communication and sharing information in collaborations and implemented the Watershed Contribution Exchange.

Throughout the grant, CW faced numerous challenges. The most prominent were challenges related to changes in personnel, keeping pace with the rapidly changing technology environment, and cultivating partnerships across the bay. Prior to the start of the grant, the UCB-CW Faculty Coordinator, Professor Don Dahlsten, passed away. In addition to the loss of an inspiring and creative friend, CW lost their faculty liaison and primary contact to a number of partner organizations. They responded to this loss by focusing on youth and strengthening the environmental education programs of CW partners. CW also experienced multiple changes in technical staff as staff members left to pursue new career opportunities. These changes slowed the rate of technology development but ultimately the partners found alternative solutions.

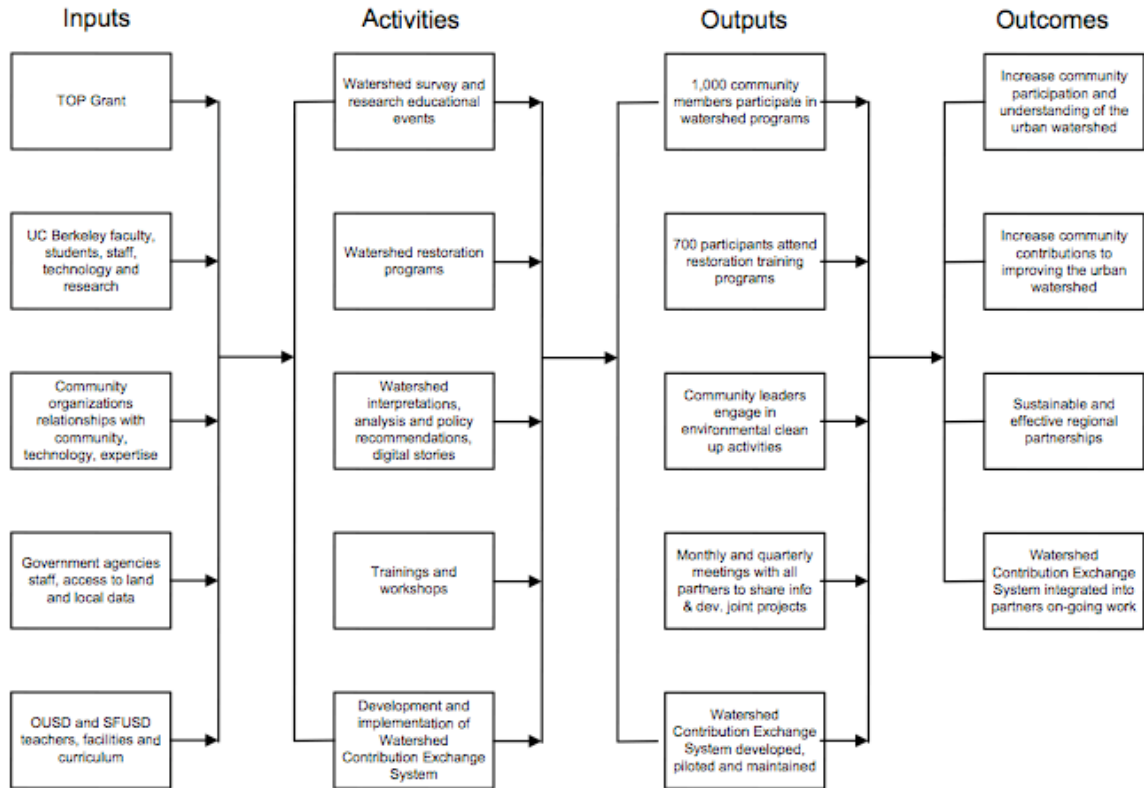
The CW project functioned in a time of rapid technology development. As CW partners worked to develop new technologies from the ground-up, new technologies with the desired functionality sprung up from both proprietary companies and the open source software development community. Rather than chasing the rapid technology development train, CW partners changed their strategy from technology development to experimentation with emerging tools and development of a toolbox of programs that offer a range of easy-to-use tools for many purposes.

CW partners originally envisioned linking watershed programs throughout the San Francisco Bay watershed. While they developed very strong networks of partners on either side of the bay, there was little cross-pollination of the programs. The logistical challenges of bringing partners from different sides of the bay together trumped the potential benefits of making these links. CW originally envisioned that these challenges could be alleviated by new web-based technologies for information sharing that would facilitate communication without the travel and relieve the need to accommodate conflicting schedules. However, project partners did not readily adopt technology for regional organization and communication (though these tools were used locally).

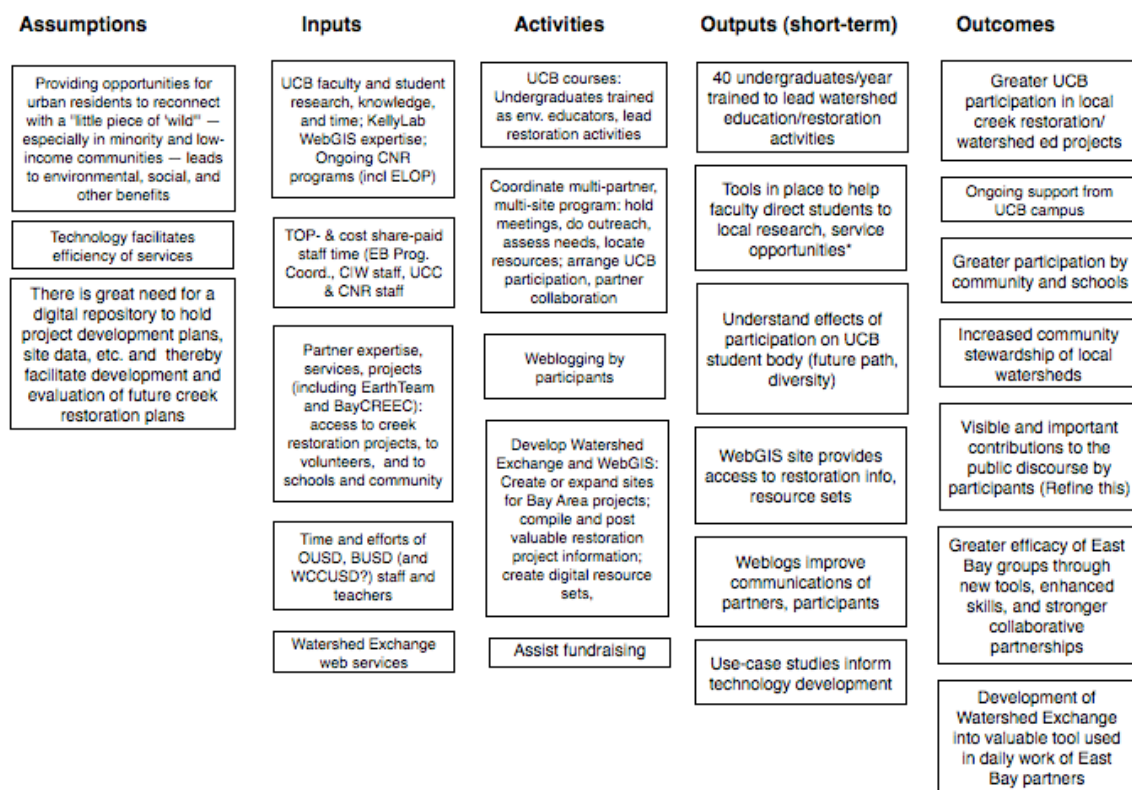
CW faced the major challenges of personnel changes, a rapidly changing field of technology, and the difficulty of uniting partners across the bay with adaptability and flexibility, changing their program activities and focus without compromising their original goals. In order to extend their success beyond the TOP grant, they identified best practices, disseminated their learning, and created new paths for continuing and extending the work of the CW project.

Appendix A: Logic Models

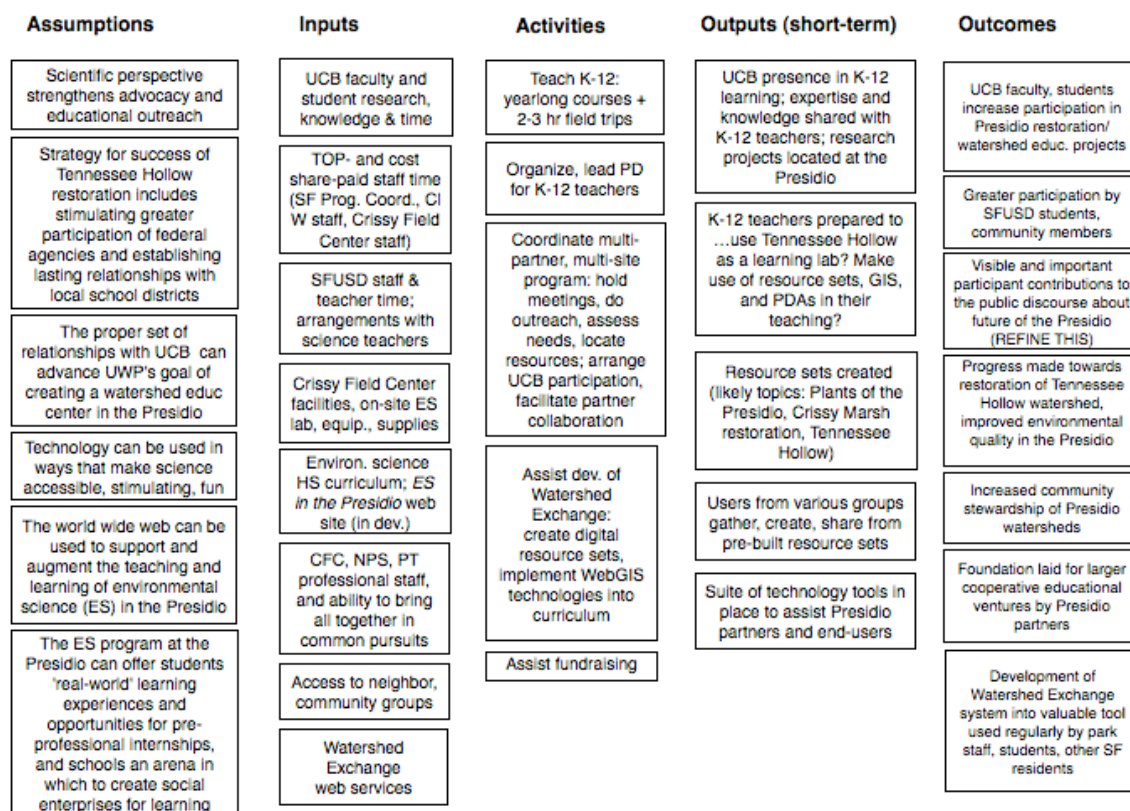
City | Watershed Project Logic Model



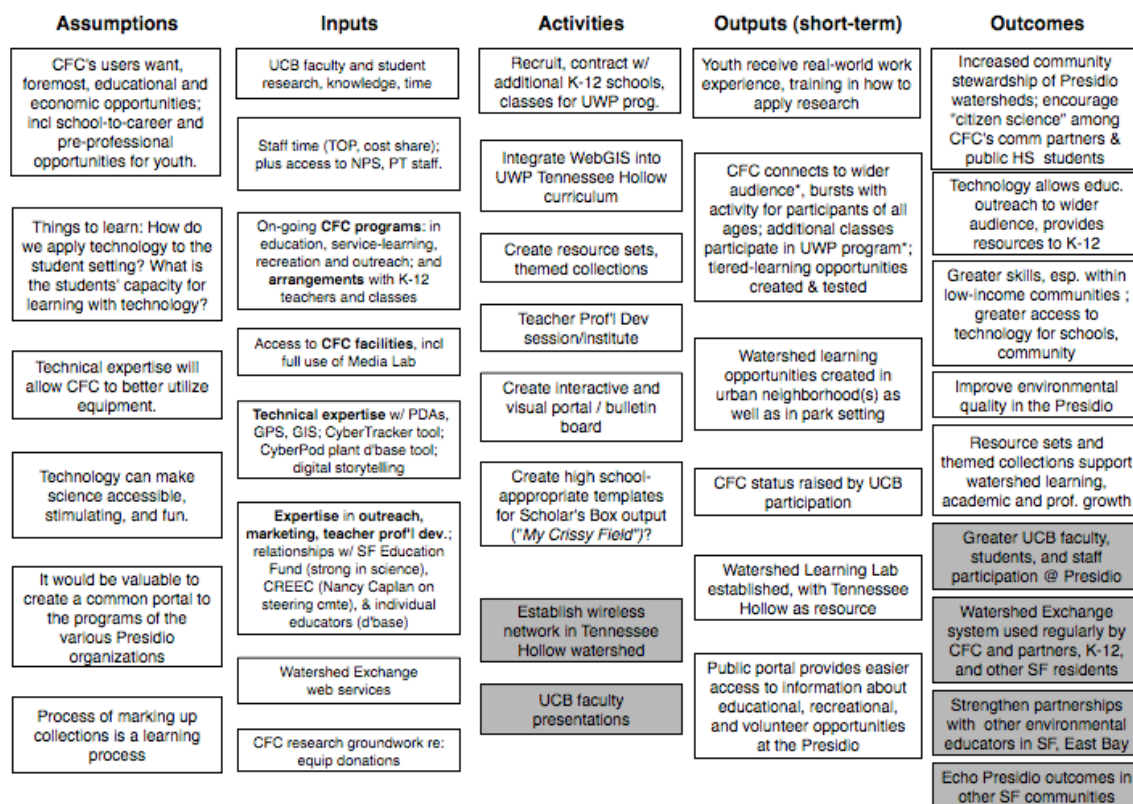
East Bay Partners Logic Model



Urban Watershed Project Logic Model



Crissy Field Center Logic Model



Appendix B: Participation Numbers

East Bay: Facilitated by College of Natural Resources Outreach

UCB Undergraduate and graduate mentors

| | Spring 2005 | Summer 2005 | Fall 2005 | Spring 2006 | Summer 2006 |
|--|----------------|----------------|--------------|----------------|----------------|
| Academic Talent Development Program (ATDP) | | 4 | | | 3 |
| Central Valley Drift Catcher | | | | | 2 |
| Early Academic Outreach Program (EAOP) | | 2 | | | |
| ESPM 178A (ESPM 190) | 12 | | 15 | 13 | |
| ESPM 178B ¹⁰ | | | | 8 | |
| Team Oakland ¹¹ | | 3 | | | 3 |
| Total | 12 | 9 | 15 | 21 | 8 |

High school students

| | Spring 2005 | Summer 2005 | Fall 2005/ Spring 2006 | Summer 2006 |
|---------------------------------------|----------------|----------------|---------------------------|----------------|
| Berkeley High School | | | 150 | |
| Briones Environmental Science Academy | | | 60 | |
| Central Valley Drift Catcher | | | | 5 |
| East Bay Conservation Corps | | | 60 | |
| La Conte Elementary | | | 50 | |
| Luther Burbank Middle School | | | 90 | |
| Mt Diablo High | | | 220 | |
| Oakland High School | 66 | | 100 | |
| Oasis High School | 50 | | 25 | |
| Richmond High School | 115 | | 60 | |
| Richmond After School | | 12 | 15 | 12 |
| Team Oakland | | 80 | | 115 |
| YEP Charter School | | | 20 | |
| Total | 231 | 92 | 850 | 132 |

¹⁰ Students in ESPM 178B in Spring 2006 completed ESPM 178A in Fall 2005 and are included in both counts on this chart.

¹¹ Two of the Team Oakland mentors also participated in ESPM 178A and are included in both counts on this chart.

San Francisco: Facilitated by Urban Watershed Project

| High school students | | |
|-----------------------------|-----------|------------|
| | 2004/2005 | 2005/2006 |
| Galileo High School | 18 | 50 |
| Gateway High School | | 45 |
| Jefferson High School | | 40 |
| University High School | | 20 |
| XCEL | 30 | |
| Total | 48 | 155 |

Appendix C: University of California, Berkeley Faculty Participation

| Faculty Member | Title and Department | Role in City <i>Watershed</i> Project |
|---------------------|---|---|
| Reginald H. Barrett | Professor, Environmental Science, Policy & Management | <ul style="list-style-type: none"> Facilitated session of Academic Talent Development Program (ATDP) |
| William B. Berry | Professor, Earth and Planetary Science | <ul style="list-style-type: none"> Research collaboration with UWP Joint presentations on environmental education with Doug Kern |
| Ignacio Chapela | Associate Professor, Environmental Science, Policy & Management | <ul style="list-style-type: none"> Provided environmental science content for ESPM 178A |
| Sally Fairfax | Associate Dean of Instruction and Professor, Environmental Science, Policy & Management | <ul style="list-style-type: none"> Administrative support for CW Provided environmental science content for ESPM 178A |
| Inez Fung | Professor, Earth and Planetary Science | <ul style="list-style-type: none"> Provided environmental science content for ESPM 178A |
| Maggi Kelly | Associate Specialist in Cooperative Extension and Adjunct Associate Professor, Environmental Science, Policy & Management | <ul style="list-style-type: none"> CNR Faculty Coordinator Provided technical and GIS support for CW |
| Matt Kondolf | Associate Professor, Landscape Architecture and Geography | <ul style="list-style-type: none"> Research collaboration with UWP |
| Deborah McKoy | Director, Center for Cities & Schools Lecturer, Department of City and Regional Planning | <ul style="list-style-type: none"> Program evaluator Facilitation of connections with San Francisco Unified School District Consultation on SEfL and Environmental Education |
| Garrison Sposito | Professor, Environmental Science, Policy & Management | <ul style="list-style-type: none"> Provided environmental science content for ESPM 178A |

Appendix D: University of California, Berkeley Educational Partnership Roundtable Participants

| Participant | Organization |
|-----------------------|--|
| Teresa Arriaga | • Early Academic Outreach Program |
| George Gagnon | • Center for Underrepresented Engineering Students |
| Jerlena Griffin-Desta | • UCB Office of Student Development |
| Quinn Hearne | • Lawrence Hall of Science |
| Heather Hood | • Institute of Urban and Regional Development Center for Community Innovation |
| Marsha Jaeger | • UCB Center for Educational Partnerships |
| Bob Jorgensen | • California Preparatory Academy High School • UCB Center for Educational Partnerships |
| Gail Kaufman | • California Preparatory Academy High School • School/University Partnership • UCB Center for Educational Partnerships |
| Maggi Kelly | • College of Natural Resources • Geospatial Imaging and Informatics Facility |
| Monica Montenegro | • East Bay Consortium |
| Jose Rivas | • Destination: College |
| Judy Scotchmoor | • UC Museum of Paleontology • Berkeley Natural History Museums |
| Charles Underwood | • UC Links |
| Ron Williams | • UCB Transfer, Reentry, and Student Parent Center |

Appendix E: City | *Watershed* Partners

| Core Partners | |
|---------------------------|--|
| | Partner |
| UCB Campus | IST – Interactive University Project College of Natural Resources |
| Off-campus, East Bay | East Bay Schools (listed in Appendix B) Oakland Unified School District Urban Creeks Council |
| Off-campus, San Francisco | Urban Watershed Project Crissy Field Center/Golden Gate National Parks Conservancy Galileo Academy of Science and Technology National Park Service Presidio Trust San Francisco Unified School District |
| Extended Partner Network | |
| | Partner |
| UCB Campus | UC Botanical Garden |
| | Center for Cities and Schools |
| Off-campus, East Bay | Alameda County Office of Education |
| | Contra Costa College |
| | EarthTeam |
| | Friends of Sausal Creek |
| | Headlands Institute |
| | Lawrence Hall of Science |
| | Pesticide Action Network North America |
| | San Francisco Estuary Institute |
| | Save the Bay |
| Off-campus, San Francisco | Alliance for a Clean Waterfront |
| | California Native Plant Society |
| | Center for Biological Diversity |
| | Dune Ecological Restoration Team |
| | Golden Gate Audubon Society |
| | Natural Resources Defense Council |
| | Nature in the City |
| | San Francisco League of Conservation Voters San Francisco Tomorrow |

Appendix F: Sample Lesson Plan

Walk to Lake Merritt

Created by Ms. Katie Noonan

September 2006

Objectives:

1. Students will explore the concept of a watershed by walking through one from Oakland High School, down MacArthur Blvd. Hill to Lake Merritt.
2. Students will observe and quantify categories of litter.
3. Students will recognize other impacts: oil and chemicals on road, culverting of creeks, covering land with concrete and asphalt.
4. Students will learn the difference between the sewer system and the storm drain system.
5. Students will apply math skills and technology skills to construct pie charts and bar graphs by hand and with excel.
6. Use city blocks as introduction to map coordinate systems.

Materials: Maps of [California](#), [S.F. Bay Area](#), and [Lake Merritt watershed](#).
(http://www.lakemerrittinstitute.org/lmi_pic_075.jpg)

Storm drain map of Lake Merritt area

Top Polluters article (S.F. Chronicle 1998)

Notebooks and pencils.

Calculators, Computers with internet and excel.

Video, Our Synthetic Sea by [Algalita Foundation](#)

Key Terms:

Watershed

Ground Water

Sewer System

Run-Off

Urban Run-Off

Culverted Creeks

Storm Drain System

Pollution

Water Cycle

Recyclable

Biodegradable

PRE-TRIP: Have class look at maps of California, Bay Area and local area. Discuss topography's effect on water and drainage patterns. Notice the encroachment of human development on landscape. How has this changed the flow of water off the land?

Read the article, Top Polluters, and answer fill-ins. Review Key Terms.

CAUTIONS: For safety, stay on sidewalks. Cross in crosswalks. Stay with partners (students work in pairs). Conduct: Make way for members of the community. Do not step on gardens or sit on or touch cars. Do not make noise or be boisterous. Respect property. Stay off lawns, etc. Do not dis' condition of people's yards, trash areas, or anything else in their earshot. Use polite language.

Have students set up field notebooks for data collection. All notebook pages should be dated and location noted. Time should be recorded. On the left side, students will record

freehand observations. Review with them what makes for good observations (description, quantifying, using all senses that are safe (no tasting, but smelling and in some cases touching OK)).

Right side will have data table:

| BLOCK | PAPER/CARDBOARD | METAL(steel) | ALUMINUM | GLASS | PLASTIC | YARD WASTE | OTHER |
|------------------|-----------------|--------------|----------|-------|---------|------------|-------|
| School to Alma | | | | | | | |
| Alma to Capell | | | | | | | |
| Capell to Spruce | | | | | | | |
| Etc. | | | | | | | |

As students walk along MacArthur Blvd., they will record the type of trash item (newspaper, plastic bottle) and the numbers of such items for each block. We will stop and discuss other relevant observations as we walk. Students are responsible for recording notes about these as well. They should add their own questions and observations.

TRIP: Review CAUTIONS. Students need to group together quickly to listen and take notes. Ask for more time, if needed. Do not lag behind or talk. Notes will be graded.

Some points to note:

- 1) Compare grassy and concrete surfaces. What will happen to water that falls on each? What was the original land surface? How much of the watershed is now concrete?
- 2) Observe water in gutter. Where does it come from (sprinkler system and leaky pipes). What will dissolve or be carried away in water.
- 3) Observe chemical spots on road. Recall details from Top Polluters about what traffic puts on road.
- 4) E-waste. Why are old computers, electronics, and batteries a concern? New battery rules. Export of “properly” returned electronics to Asia for recovery of metals, other re-usables. Human rights, labor and environmental concerns. Idea of extended product responsibility for manufacturers.
- 5) Storm drains. Discuss why they are there (to prevent flooding) and where the water goes. Read sign. Jugs of oil by storm drains – a common dumping problem. Mention stenciling as a community service project. Note that water that enters the storm drain is not treated, unlike sewage water which goes to a water treatment plant before it is released into the environment. Sewer water must meet standards before it is released.
- 6) Line of trees along MacArthur Blvd. marks location of old Trestle Glen Creek. There is probably underground water flow and a culverted creek. If time discuss the difference between an open urban creek and a culverted one. Daylighting movement.
- 7) Note recycling bins used by neighbors.

- 8) Note gardens and evidence of fertilizer or insecticide use.
- 9) Note native and alternative land covers.
- 10) Note construction zones as sources of pollution.
- 11) Birds at Lake Merritt depend on the water: Observe birds and list ways they use the water.
- 12) 88 storm drains enter the lake (observe). Smell decomposition. Note fountain that provides oxygen so aquatic life can survive. Bacteria can use up all the oxygen while decomposing trash and algae (eutrophication), leading to fish kills.
- 13) Note the petrobarrier and discuss storm drain filter installation and cleaning.
- 14) Note turtles: People release freshwater turtles into lake. Unfortunately, lake is saltwater and the turtles will die if not rescued.

POST TRIP:

1. Follow directions to make a pie chart showing trash types you observed on the whole walk. UPLOAD to City Watershed EXCHANGE, according to teacher instructions.
2. View video, “Our Synthetic Sea”.
3. Answer analysis questions.

ANALYSIS QUESTIONS:

1. Define Lake Merritt watershed and relate to our walk.
2. How does your waste piechart compare to the one in your book (p. 23) for the U.S. in general? Explain the differences (make hypotheses).
3. Do you think the chart would be different before or after lunch on our open campus? Make a prediction.
4. What might happen to the plastic trash we observed? (Refer to “Our Synthetic Sea”.)
5. What were “invisible” forms of waste or pollution that we passed on our way which might affect the Lake Merritt watershed?
6. How is storm drain water different from sewer water?
7. What happens to the yard waste that is collected?
8. How much of the trash on MacArthur Blvd. could have been recycled? How much could have been reduced (done without)? Why do you think people do not reduce, reuse or recycle this material?

Regular Folks Are Top Polluters of Waterways, Report Says

Yard chemicals, auto brake pads add to runoff

By Charles Pett
Chronicle Science Writer

Don't blame big factories spewing noxious wastes, unscrupulous midnight dumpers or overloaded sewage plants for all the pollution reaching rivers, streams and bays.

Take a look in the mirror.

Experts are coming to the view that the daily crud ordinary people spread around the landscape — chemicals put on backyard gardens, motor oil dripped on city streets and garage messes hosed into the gutter — is the No. 1 source of water pollution in California and the nation.

It may also be the toughest to tackle.

A report being released today by the Lindsay Museum in Walnut Creek warns that a quarter-century of progress toward cleaner water in California will soon be reversed unless tougher steps are taken to control urban runoff.

Thirty to 70 percent of the man-made chemicals detected in San Francisco Bay come from polluted urban runoff, the report says. Along the Alameda County shoreline, 75 percent of the chromium and 64 percent of zinc — metals potentially harmful to wildlife — are washed off city streets.

One big reason for the problem is public ignorance.

"We did a study in 1992 that found that only 13 percent of the population knew that storm drains lead directly to the bay," said Shar-

on Gosselin of the Alameda County-Wide Clean Water Program. "Most people thought it all went to a treatment plant, or they just did not know."

In fact, the city of San Francisco is one of the few communities in the country with a single-water treatment system that handles both sewage and storm runoff. Nearly everywhere else, storm drains lead straight to creeks, rivers and, eventually, lakes or

The Lindsay Museum report, prepared with a grant from the U.S. Environmental Protection Agency, echoes the findings of other recent studies by local, state, federal and independent researchers. The studies note rapid progress in capping the most obvious sources of dirty water — raw or poorly treated sewage and factory

discharges. The kinds of concentrated pollution that, in an infamous 1969 incident, caused the Cuyahoga River in Cleveland to catch fire are now rare.

"We put the screws to the sewage plants and industrial plants. There just isn't much more there to clean up," said Gail Boyd, an engineer at Woodward Clyde Consultants, a nationwide firm that has managed major EPA analyses of pollution problems.

Boyd recalled that as long ago as 1970, he took part in studies showing that in a typical city, the pollution in a year's worth of storm runoff equaled that from sewage treatment plants. Since then, great progress has been made on sewage, but very little on general runoff.

In Alameda and Santa Clara counties, storm water running

down creeks can pick up so much insecticide from suburban yards that it sometimes kills water fleas exposed to it in laboratory tests, indicating a serious threat to aquatic food chains.

Most of the copper in the southern reaches of San Francisco Bay — which exceeds federal copper standards for aquatic life — is road dust from brake pads on cars and trucks.

"We weren't sure where all the copper was coming from," said Roger James, operations manager for the Santa Clara County Water District. "So we ground up the brake pads from about 20 different cars, and there it was."

Thomas Mumley, urban runoff coordinator for the San Francisco Bay Regional Water Quality Control Board, said that about 190,000 pounds of metal flow into the

South Bay in storm waters each year compared with 110,000 in treated sewage.

"Urban runoff is one of the least managed sources of pollutants to the bay," he said. "Public education and participation is the key ingredient . . . and is the highest priority for early action."

Doing something about urban runoff will be difficult.

One simple response has been to label storm drains so people know they lead straight to the bay. The tactic, started in Santa Clara County, is now common elsewhere.

New rules controlling runoff from construction sites, regulating the composition of garden chemicals, brake pads and other widely used materials, and raising fines

for illegal dumping in storm drains are all on the books or in the works.

Nobody has a price tag for such prevention programs, however, and neither Congress nor the nation's taxpayers seem in the mood for expensive new environmental programs.

"We have no clear national goals with regard to storm water, but we do have goals to be sure the waterways are clean enough for fishing and swimming," Boyd said. "If you ask yourself, can you meet those goals without treating storm water, then the answer is no."

NAME _____

BIOLOGY

1. The daily _____ of ordinary people spread around the landscape is the No. 1 source of water pollution in California and the nation.
2. Three sources are : _____
_____, and _____
3. A report warns that a quarter century of progress toward cleaner water in California will soon be reversed unless tougher steps are taken to control _____
4. _____ potentially harmful to wildlife are washed off city streets.
5. One big reason for the problem is _____
6. Most people do not know that storm drains lead straight to _____
and eventually _____
7. Rapid progress has been made in capping the most obvious sources of dirty water: _____ and _____
8. In 1969, the _____ River was so polluted, it _____
9. Insecticides from suburban backyards are a threat to _____
10. Conner pollution in San Francisco Bay comes from _____
11. A simple way to fight urban runoff is to _____
(The O-High Environmental Club is doing this in Oakland!)
12. New rules will (1) _____
(2) _____
and (3) _____
13. To meet national clean water goals, we will have to treat _____

MAKING A PIE CHART FOR YOUR TEAM'S TRASH DATA

Launch Internet Explorer

Select City Watershed from Bookmarks or go to <http://citywatershed.migcom.com/>.

To enter the site use the USERNAME=**esa-student**. The PASSWORD is **ohsesa2006**.

On the Welcome page, under the Find Your Group drop-down menu choose **Oakland HS Env Science Acad.**

The screen will change to let you choose either **Katie Noonan's Class Home Page** or **library documents**. Click on **library documents**.

Choose **Lake Merritt Walk**

Choose **Student Trash Data 20060907** then **Get View**

The spreadsheet will download the sheet to the computer. **** From the File menu choose "Save as" using your names in the filename, e.g. "Mrs Noonan's trash chart."**

Go to the "Team Data by Block" worksheet for your class.

3. Type in your names into heading cell A1
4. Type data into the columns B2 to B12 (B2:B12) according to trash type and block.
5. Select the data in a column and press Autosum symbol in the toolbar to total your trash for each category. Enter those totals into a column on the Total Trash worksheet for your class period.

MAKING THE PIE CHART (TEAM TOTAL TRASH For WALK)

1. Select the labels for the pie slices. Drag the pointer from cell B1 to cell H1 (B1:H1).
2. Select the cells that hold the data. **This time hold down Ctrl while you drag.**
3. Click Chart Wizard button in the tool bar. Choose pie chart. Follow instructions make the chart (**Choose a title with your names in it!**).
4. Save your chart as a separate page.
5. **SAVE** the file in My Documents.

MAKING THE PIE CHART (CLASS TOTAL TRASH For WALK)

1. Sum up the data for all teams in the class. On the Total Trash worksheet, select the data in a row, then press Autosum symbol. The class total for all teams for that kind of trash should appear in the cell to the right of the selected data. Choose Edit Copy in that cell. Drag the cursor down the column to the last row, and choose Edit Paste. The sums for the remaining rows will be calculated.
2. Select the labels for the pie slices. Drag the pointer from cell A2 to cell A8 (A2:A8).
3. Select the cells that hold the data in the last column to the right. **This time hold down Ctrl while you drag.**
4. Click Chart Wizard button in the tool bar. Choose pie chart. Follow instructions make the chart (**Choose a title with your names in it!**).
5. Save your chart as a separate page.
6. SAVE the file in My Documents.

MAKING A BAR GRAPH CHART (CLASS TOTALS BY BLOCK)

This chart will compare trash profiles for each block as we go from school to the lake. Because there were many short blocks in the middle, which were recorded differently by different groups, we will only do the first 3 and the last one.

1. Enter your trash totals by block onto the CLASS DATA BY BLOCK worksheet for your period. Your team's data will go in a column, headed by your team name. Sum up the data for all teams in the class into the last column. Select the data in the first row (B2:B end), then press Autosum symbol. The class total for all teams for that kind of trash should appear in the cell to the right of the selected data. Choose Edit Copy in that cell. Drag the cursor down the column to the last row, and choose Edit Paste. The sums for the remaining rows will be calculated.
2. Select the labels for the blocks. Drag the pointer from cell A2 to cell A8 (A2:A8).
3. Select the cells that hold the data in the last column to the right. **This time hold down Ctrl while you drag.**

4. Click Chart Wizard button in the tool bar. Choose bar graph. Follow instructions make the chart (**Choose a title with your names in it!**). Be sure to include a legend and descriptive title.
5. Save your chart as a separate page.
6. SAVE the file in My Documents.

FOR ALL GRAPHS: Print your charts and paste them into your field notebook. In your field notebook, write a paragraph explaining what your graph shows. Use the graph to support an answer to a question in the lesson, or a question of your own.