

Results of Needs Analysis:

High School Science Teachers Perspectives about the Needs in Estuary Education in the Bay Area

A Report Submitted to
San Francisco Bay National Estuarine Research Reserve

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Executive Summary

NOAA's National Estuarine Research Reserve (NERR) System conducts research and long-term water-quality, meteorological, and biological monitoring at 28 Reserves around the country. The Reserve System also offers unique education programs and materials for science teachers and students. Currently there is an interest in expanding the K-12 programs offered by the San Francisco Bay NERR to schools in Marin and Solano Counties. The Reserve was interested in knowing more about who would participate in the various programs, what kinds of programs schools would participate in, and hurdles that would influence their participation. The current needs-assessment focused on high school science teachers. These teachers had the opportunity to participate in a focus group or do an online survey. The purpose was to find out their current needs as well as learn what kinds of programs and professional development opportunities should be developed and implemented. This needs-assessment had two different phases. The first phase involved recruiting teachers to participate in focus groups and take an online survey and the second phase involved recruiting teachers who could not participate in the focus groups to take a more detailed online survey. Findings included:

- More teachers in Solano County have less or no experience teaching estuary-related topics compared to Marin. In Solano County more teachers have experience teaching ocean topics, but have less experience with estuaries and watershed topics. In Marin County the teachers have the same amount of experience teaching all of the estuary-related topics.
- Solano and Marin Counties had very significant differences in the amount of time spent on estuary-related topics. Half the teachers in Solano County did not spend any time with estuaries and about a third did not spend any time with watersheds. In Marin County, most teachers spent several class sessions discussing various topics in this area.
- Tamalpais Union High School District (which includes 5 high schools) in Marin County has an entire 6 to 8 week unit devoted to teaching students about the San Francisco Bay in ninth grade. It is part of a two year Integrated Science Program that is implemented in that district.
- Marin County teachers have a fairly strong emphasis on outdoor experiential activities. Neither county has a strong emphasis on stewardship projects or activities. Teachers from both counties seem to emphasize lab or field work/data collection, data analysis, and scientific inquiry skills.
- Many Marin County schools had natural water sources (creeks or wetlands) near the school sites that were utilized by the teachers. Most Solano County schools did not have this access so it is more difficult for them to integrate water studies into a class or lab period.
- In both counties, a majority of the teachers have had no estuary-related professional development training. In Marin County, about half of the teachers have had some type of ocean-related training.
- Teachers in Solano County felt they had very little support financially and administratively to participate in professional development training while in Marin County many of the teachers felt they had support for professional training.
- Most of the teachers had no awareness of the San Francisco Bay NERR and as a

- result very few are using the services and products.
- In both counties, the largest group of teachers felt that they would like professional training support in incorporating new lab activities. In addition, in Solano County a large percentage of teachers would like more support with facilitating inquiry-based activities.
 - Many teachers discussed wanting to have more field trips and having programs related to learning about data collection and sampling in the field for students.
 - The teachers liked all of the possible NERR programs, but the student internship program was the one most strongly preferred by all the teachers. Most teachers thought it was more possible based on time and resources in their schools. The teachers, especially in Marin County, also were excited about the Water Quality Program, but they had more reasons of why they would not be able to participate in that program.
 - In Solano County, the biggest obstacle to participation was general funding and transportation costs. There were also several teachers who felt they could not participate in any programs that do not help their students prepare for the state exam. Marin County teachers had less obstacles and funding was less of an issue. The largest group of teachers had concerns about the timing of the activity.

Recommendations:

1. The two counties (Solano and Marin) had very different experiences, needs, and obstacles.
 - a. Solano County is larger and finances are a much bigger concern for this group of teachers. These teachers have less freedom (because of testing and standards) to try new things in the classroom. For this County, teachers would be more likely to utilize programs such as having speakers come to the schools, students having access to more data and datasets in the classroom, and sharing data among different groups or schools. It was more difficult for many of these students to do outdoor activities at school, so we recommend bringing laboratory activities to the classroom to make the science more hands-on. However, any new activities would have to relate directly to existing district curriculum.
 - b. Marin County had less concerns financially, but had more concerns about time. Some of the teachers discussed testing, but there was not the same pressure and teaching restrictions as in Solano County. These teachers had more flexibility in being able to bring new materials to the classroom and participating in professional development. New materials and professional development programs in estuary-related topics would be useful for this county and teachers had interest in participating. One of the districts has a San Francisco Bay course that the teachers feel needs some updating and current material; this could be a good avenue for the NERR to pursue. Also most of the schools in this county are near some type of natural waterway so they have flexibility to do some outdoor work related to water at the school site. The access to the natural waterways has much potential for a possible NERR Water Quality program.
2. Many teachers were not familiar with NERR and its resources. The teachers at the

- focus groups and many of those who took the survey seemed interested in learning more about the organization and its resources. If the goal is to have more teachers and classrooms using the resources and programs, then NERR needs to figure out new ways to advertise and let others know what they are doing (i.e. open houses, talking to schools, internships, etc.)
3. Many of the teachers felt that it was important that any programs, professional development, materials, etc. that are developed need to fit in with the curriculum or with the standards that are already being taught. Any educational materials that are developed should show teachers how these materials could fit into the curriculum in specific science subject areas.
 4. Many teachers discussed or named LiMPETS [NOAA National Marine Sanctuary program - Long-term Monitoring Program and Experiential Training for Students] in both the surveys and the focus groups as a positive experience. This coastal ocean program could be used as a model in designing a new watershed or estuary-related program for both counties.
 5. It would be useful to examine these two groups of teachers several years from now to find out how a change in political and economic climate affects both of these counties. In addition, to find out if by developing more materials, support, and professional development the NERR and its programs have become more known by teachers and schools.

Introduction

Background

NOAA's National Estuarine Research Reserve System (NERRS) conducts research and long-term water-quality, meteorological, and biological monitoring at 28 Reserves around the country. The Reserve System also offers unique education programs and materials for science teachers and students. Many of these programs incorporate field research opportunities and classroom-based research and data analysis. In San Francisco Bay, the Reserve includes two sites: China Camp State Park in Marin County and Rush Ranch Open Space Preserve in Solano County. China Camp protects some of the best remaining salt marsh in the estuary, as well as critical rocky intertidal and mudflat habitat, and the surrounding forested uplands. Rush Ranch protects a tidal brackish marsh that is further up the estuary and is part of the larger Suisun Marsh. Rush Ranch's marsh is surrounded by hills with open grasslands and pastures for horses.

Existing Programs

Each year, the Reserve offers a few programs for high school and college students, as well as teachers. In partnership with San Francisco State University's Romberg Tiburon Center they offer one or two professional development workshops for science teachers each year. These one-day workshops feature lectures by scientists, as well as hands-on activities and field explorations related to the lecture topics. They also offer field research experiences for college groups.

Goals of Current Needs-Assessment

Currently there is an interest in expanding the current programs for K-12 schools in Marin and Solano Counties. The Reserve was interested in knowing more about who would participate in the various programs, what kinds of programs schools would participate in, and hurdles that would influence their participation. A market analysis was conducted to find out which audience should be targeted (results of this analysis are published in a separate report). The results indicated that high school students and teachers were audience potential target audience whose needs the Reserve staff felt like their programs could address. As a result, the current needs-assessment focused on high school science teachers in Solano and Marin Counties. These teachers had the opportunity to participate in a focus group or do an online survey. The purpose was to find out their current needs as well as learn what kinds of programs and professional development opportunities should be developed and implemented.

Methodology

This needs-assessment had two different phases. The first phase involved recruiting teachers to participate in focus groups and take an online survey, and the second phase involved recruiting teachers who could not participate in the focus groups to take a more detailed online survey.

Phase 1

In the first phase, science high school teachers from Solano County (100 teachers) and Marin County (76 teachers) were contacted by email in June 2011 to participate in an

hour and a half focus group during the summer. Approximately twelve of those emails bounced back and we were not able to find out the status of those teachers. We recruited most of the teachers from public high schools, but we included a few private high schools as well. The teachers could either participate at Rush Ranch in Solano County or at the Romberg Tiburon Center in Marin County. As an incentive, we gave the teachers a \$40.00 gift card from Amazon and either a tour of the Romberg Tiburon Center (Marin County) or a nature walk at Rush Ranch (Solano County). The teachers who participated in these focus groups also took a short online survey to help learn more about their backgrounds. In Marin County, we conducted two different focus groups, the first one had four teachers and the second one had two teachers. In Solano County, we conducted one focus group with three teachers participating. A total of nine teachers participated in the focus groups and did the online survey. See Appendix A for a copy of the focus group protocol and the online survey. At the focus group, Sarah Ferner (the Reserve's educator coordinator) introduced the teachers to the NERR's programs and discussed the purpose of the focus groups. Then one researcher led and monitored the focus group, while the other researcher took notes on the discussion. The researchers used a digital voice recorder. After the focus group, Sarah Ferner led the optional tours and the nature walks. The focus groups and online survey included questions about background teaching watershed/estuary-related topics, professional development, watershed/estuary-related topics would like to learn more about, possible support/programs/professional development that the NERR could offer, hurdles to participating in the NERR programs, and familiarity/utilization of California's National Estuarine Research Reserves.

Phase 2

In the second phase, high school science teachers who did not participate in the focus groups were recruited to take a more detailed online survey using SurveyMonkey. These teachers were contacted by email followed by two email reminders. The survey took about 20 minutes to complete and as an incentive teachers received a \$20.00 gift card from Amazon. See Appendix B to view a copy of the survey. Thirty-four teachers participated. That included 15 teachers from Marin County and 19 teachers from Solano County. The survey included questions about background teaching estuary-related topics, professional development, estuary-related topics would like to learn more about, possible support/programs/professional development that the NERR could offer, hurdles to participating in the NERR programs, and familiarity/utilization of California's National Estuarine Research Reserves.

Findings

The following section reports information about the participants and major findings from the results. Throughout this entire report, the data from Marin County and Solano County will be discussed separately. As we started talking to the teachers and examining the data, we realized that the two counties had very different needs and concerns. Also both of these counties have a connection to a different estuary.

General Information about Teachers who Participated

In regards to the response rate for both phases, a total of 22 Solano County teachers out

of about 100 participated (22%) and a total of 21 teachers out of about 76 teachers in Marin County participated (28%).

Despite the low response rate, the teachers came from a diversity of high schools in both Solano and Marin Counties, so the data does a good job representing the diversity of teachers across each of the counties. Tables 1 and 2 include the percent of teachers that came from each high school for Solano and Marin Counties.

Table 1: PERCENT OF SOLANO COUNTY HIGH SCHOOL TEACHERS WHO PARTICIPATED FROM RECRUITED SCHOOLS

Schools	N=	Percent
Fairfield	4	18%
Angelo Rodriguez	3	14%
Armijo	3	14%
Vacaville	3	14%
Vanden	3	14%
Will C. Wood	2	9%
Mare Island Technology Academy (Charter School)	2	9%
Benicia	1	5%
Dixon	1	5%
Country	0	0%
Jesse M. Bethel	0	0%
Vallejo	0	0%

According to the Solano County of Education (2009-2010), the students from this county have a fairly diverse ethnic background including American Indian - 0.8%, Asian – 3.5%, Pacific Islander – 1.1%, Filipino – 8.4%, Hispanic – 30.9%, African American – 15.1%, White - 27.0%, Two or More Races – 6.0%, and Not Reported – 7.2%.

Table 2: PERCENT OF MARIN COUNTY HIGH SCHOOL TEACHERS WHO PARTICIPATED FROM RECRUITED SCHOOLS

Schools	N=	Percent
Marin Catholic (Private School)	4	19%
Redwood	3	14%
Sir Francis Drake	3	14%
San Domenico (Private School)	2	10%
San Rafael	2	10%
Tamalpais	2	10%
Marin Academy (Private School)	1	5%
Novato	1	5%
San Marin	1	5%
Tamiscal	1	5%
Terra Linda	1	5%
San Andreas	0	0%

According to the Marin County of Public Schools (2009-2010), the ethnic background of students include American Indian or Alaska Native - 0.2%, Asian – 5.5%, Pacific Islander – 0.3%, Filipino – 0.7%, Hispanic – 24.3%, African American – 2.9%, Caucasian – 59.9%, Two or More Races, not Hispanic – 3.3%, and No Response – 3.0%.

Current Teaching Experience

In both the focus groups and surveys, teachers answered questions about their school/district requirements, background, current experiences, and resource use in teaching about watersheds, estuaries, and the San Francisco Bay. In addition, teachers discussed their experiences doing fieldwork, outdoor activities, data collection, and data checking and analysis with students.

School and district requirements

All the teachers answered questions related to whether estuary or estuary-related topics were part of the school and district requirements. We report these results in Table 3. In Appendix C (Tables 1C and 2C), we include detail of which high schools require estuary-related topics. A small percentage of teachers in both counties are required to teach it as part of the curriculum.

Table 3: IS ESTUARY-RELATED TOPICS PART OF SCHOOL AND DISTRICT REQUIREMENTS?

County	School Requirement		District Requirement	
	Number of Teachers	Percent	Number of Teachers	Percent
Marin County (N = 21)	8	38%	7	33%
Solano County (N = 22)	6	27%	6	27%

Background and current teaching experience with estuary-related topics

We asked the teachers the amount of years they have been teaching various estuary-related topics in the classroom. Figures 1 and 2 show this data for Solano and Marin Counties. The data indicates that many teachers in Solano County have no experience teaching estuary-related topics. More teachers have experience teaching ocean topics, but have less experience with estuaries and watershed topics. Teachers in Marin County seem to have the same amount of experience teaching all of these topics and more teachers have had many years of experience teaching these topics than Solano County.

Figure 1: Years Teaching Estuary-Related Topics in Solano County

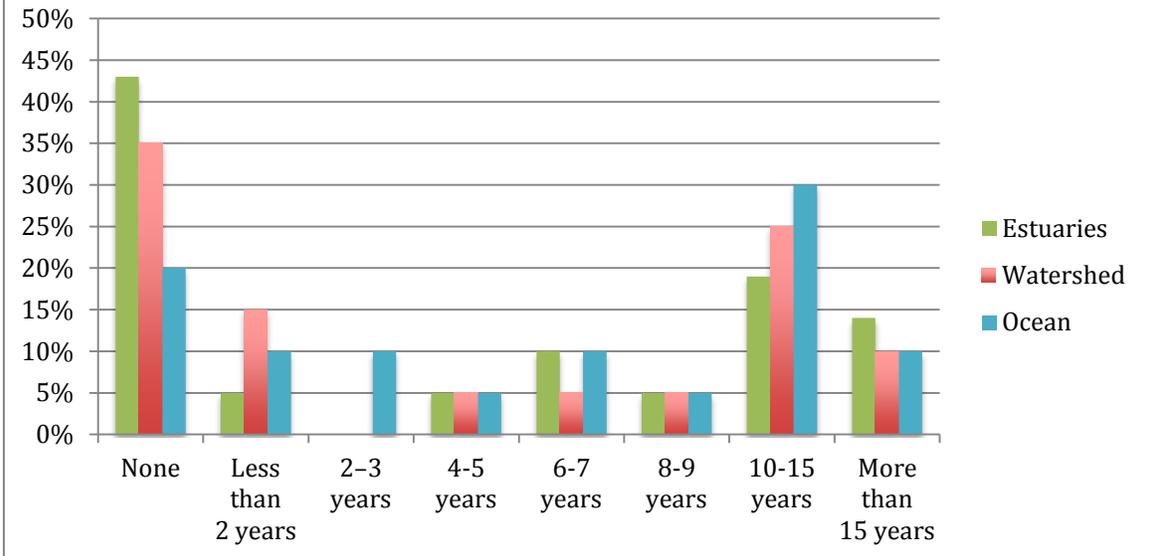
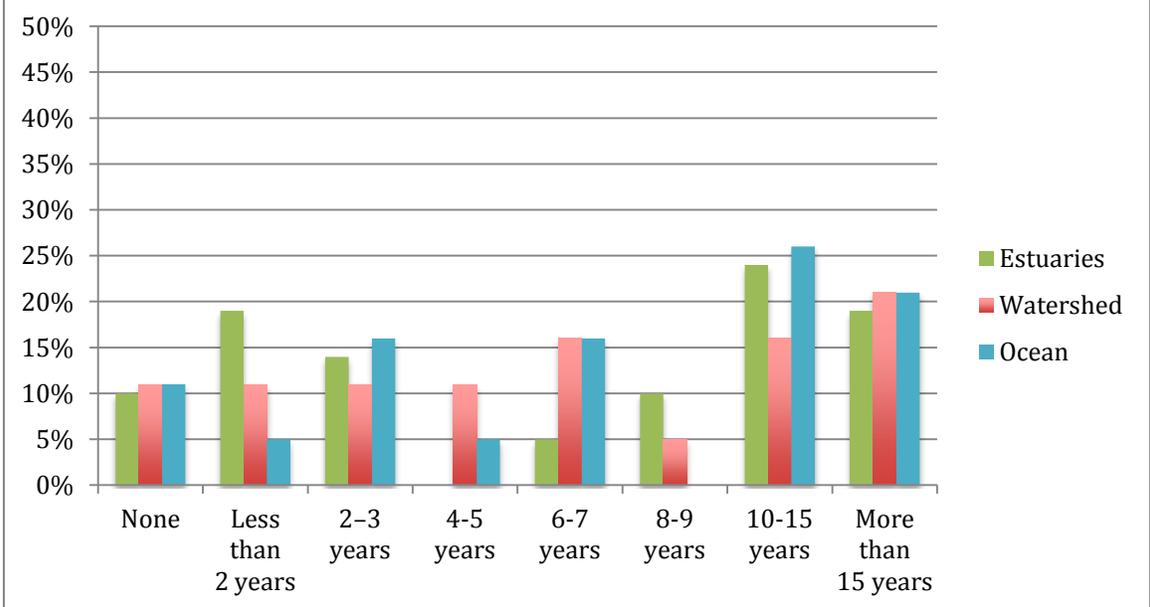
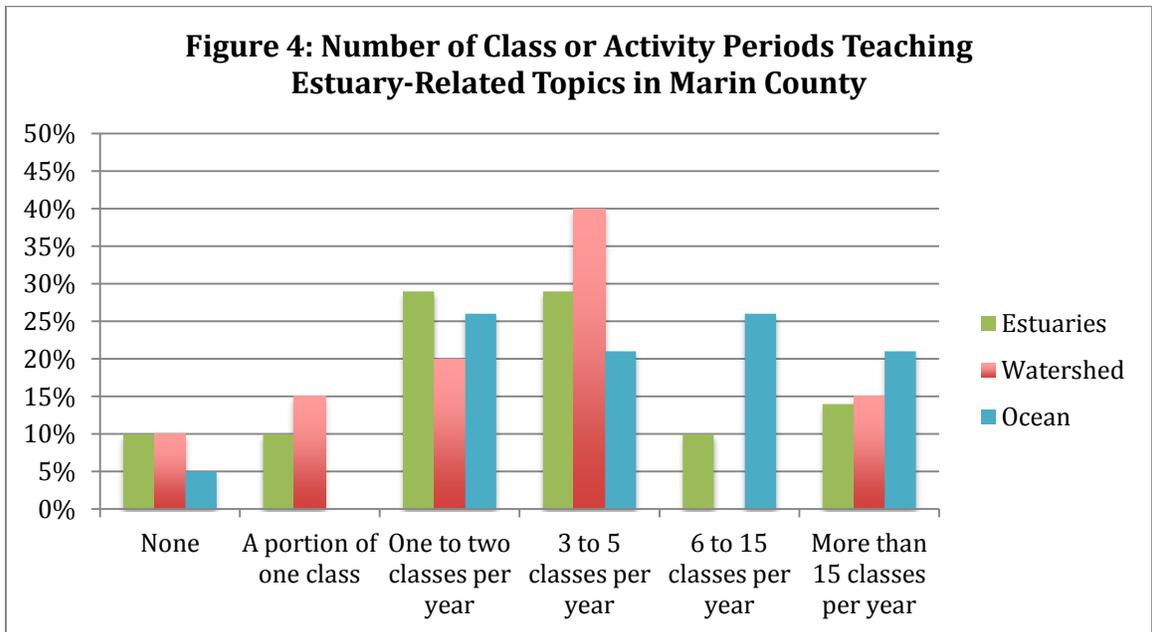
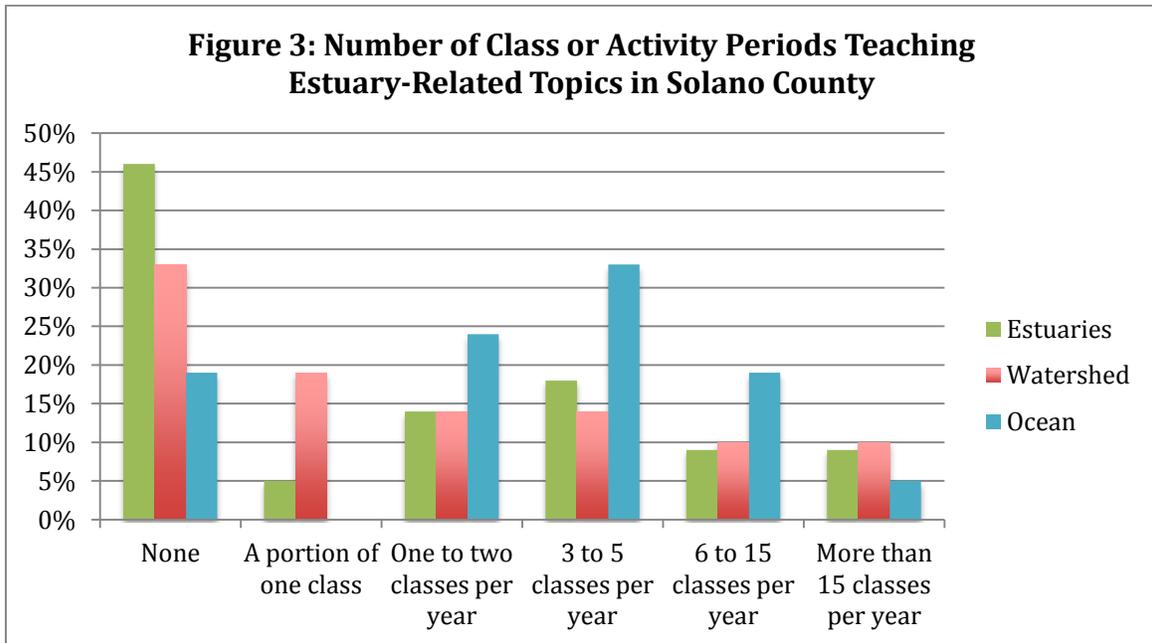


Figure 2: Years Teaching Estuary-Related Topics in Marin County



The teachers responded to questions regarding how many classes related to estuaries, watershed, and/or ocean instruction they teach a year and the topics they teach. Figures 3 and 4 include the results regarding the number of classes. For both counties many more class periods are devoted to the ocean and few are devoted to estuaries. Solano and Marin Counties had very significant differences in the amount of time spent on these estuary-related topics. Almost half the teachers in Solano County did not spend any time with estuaries and about a third did not spend any time with watersheds. In Marin County, most teachers spent several class sessions discussing various topics in this area.



The teachers discussed a wide variety of areas that they taught on estuary-related topics. Table 4 displays those results. During the Solano County focus group, the teachers discussed that often they cover these topics at a more general level rather than relating the material to their local area. By viewing the survey results, this trend was observed as well. However, there were numerous teachers making an effort to relate the material to their local area including the Suisun Bay and the San Francisco Bay. A few teachers commented that they taught Chemistry, Physics, or Biology so they did not feel the estuary-related topics related to these subjects or that it was taught in other subjects. State

testing came up in both the survey and in the focus group. The teachers used to spend more time on topics related to the environment, but that time has become more limited because of the material teachers need to cover for the state exams.

Table 4: TOPICS TEACHING IN THE ESTUARY-RELATED AREA – SOLANO COUNTY

Topics
Geomorphology of watersheds
Definition of watersheds and main watersheds in Northern California
Watersheds briefly discussed within context of Suisun Bay
Effects of acid rain on the watershed and lack of calcium in rocks to neutralize the acids
Teaches general environmental science and relates concepts to the bay area
Oceanography unit includes general information about waterways and oceans
Generally speaking about estuaries and oceans in regards to biomes and habitats in both freshwater and marine systems
Ecological Roles
Ecology and water sources, specifically the Bay Area estuaries/watersheds
“Bay Delta and how it drains the Sierra Nevada, filters water and how it is used in California. How it is important to wildlife, farmland and the balance of fresh/saltwater in the bay area and the importance of water conservation. The topics are specific to Suisun bay and SF bay and include videos, maps, readings and worksheets as well as a research project students complete.”
Covered flow of water from source to sink within watershed that feeds San Francisco Bay
Water quantity and usage
Water pollution both physical and chemical
Flow of pollution and trash
Efforts being made to maintain Bay Area estuaries/watersheds to keep them from being polluted
Water quality and water testing
Water diversion and drinking water treatment processes within context of Suisun Bay
Waste water treatment processes and ecosystem effects within context of Suisun Bay
Run-off
Salinity
How chemicals cycle through the environment (water cycle) in both positive and negative situations
Native vs. invasive endangered animals
Speciation
Importance of habitats as nurseries for fisheries
Protecting the environment
Discuss human impact
Global climate change and sea level increases (mainly general level, but local impact as well)
Compares wetlands now versus in the past using maps
Did LiMPETS [NOAA National Marine Sanctuary program - Long-term Monitoring Program and Experiential Training for Students]

In Marin County, the teachers generally spend more time teaching estuary-related topics. In addition, during the focus groups we learned that the Tamalpais Union High School District (5 high schools) has an entire 6 to 8 week unit devoted to teaching students about the San Francisco Bay in ninth grade. It is part of a two year Integrated Science Program that is implemented in that district. One teacher described the unit as including “maps and charts, tides, estuaries, food webs, trophic pyramid, hydrologic cycle, carbon cycle,

nitrogen cycle, plankton, field projects.” As a result, these teachers already have a whole unit focused on this area. During the focus group these teachers were very open to new and fresh material to enhance this course. In addition, in Marin County there seemed to be more Environmental and Marine Science type courses that were taught by more teachers. The concern about testing and having to cut back material did not come up as an issue with this group of teachers. In Table 5 the topics that these teachers are currently teaching in the estuary-related area are presented. For this county there were more teachers that taught similar topics. As a result the number of teachers who responded with each response is displayed in the table.

Table 5: TOPICS TEACHING IN THE ESTUARY-RELATED AREA – MARIN COUNTY

Topics	Number of Teachers
Course on the San Francisco Bay	6
Ecology topics	1
Wetland ecology	1
Bay ecology and geology	1
Transects and biotic/abiotic in marsh behind school	1
Biochemistry	1
Biology	2
Environmental science is only time discuss the San Francisco Bay	1
Marine Science elective class	1
Marine Science class both at a general level and a local level	2
Oceanography	1
Marine Biology	1
Field trips through Marine Science Institute on the bay	1
Biomes and aquatic systems mainly at a general level	1
Pollution sources both at a general level and a local level	2
Pollution at a general level	1
Dams both at a general level and a local level	1
Hydroelectric Power both at a general level and a local level	1
Properties of water and its ecosystem both at a general level and a local level	1
Water purification	1
Hydrologic/water cycle	2
Drinking water	1
Water quality testing	1
Water as Resource both at a general level and a local level	1
Watersheds both at a general level and a local level	2
Tidal marsh biodiversity	1
Estuaries both at a general level and a local level	1
Nutrient cycles	1
Primary productivity	1
Salt wedge	1
Biodiversity hotspot	1
Invasive species	1
Climate change	2
Rocky intertidal stuff	1
Did LiMPETS program	1
Evolution of vertebrates and mass extinctions	1
Students discuss environmental issues to come up with possible solutions	1
Science fair requirement for 10 th grade	1

Teaching approaches and experiences with students

The teachers discussed their approaches in teaching various science topics. A more

general question was asked on the survey and then during the focus group teachers spent some time discussing their approaches. Tables 6 and 7 present the data from the survey for Solano and Marin Counties. Marin County teachers have a fairly strong emphasis on outdoor experiential activities. Neither county has a strong emphasis on stewardship projects or activities. Teachers from both counties both seem to emphasize lab or field work/data collection, data analysis, and scientific inquiry skills.

Table 6: TEACHING APPROACHES – SOLANO COUNTY

Teaching Approaches	Not Applicable	Little or No Emphasis	Moderate Emphasis	Heavy Emphasis
Outdoor experiential activities	0%	68%	18%	14%
Lab or field work/data collection	0%	14%	50%	36%
Stewardship projects or activities	9%	73%	5%	14%
Data analysis, statistics, and probability	0%	0%	55%	46%
Scientific inquiry skills	0%	5%	27%	68%

Table 7: TEACHING APPROACHES – MARIN COUNTY

Teaching Approaches	Not Applicable	Little or No Emphasis	Moderate Emphasis	Heavy Emphasis
Outdoor experiential activities	0%	35%	50%	15%
Lab or field work/data collection	0%	10%	60%	30%
Stewardship projects or activities	0%	60%	30%	10%
Data analysis, statistics, and probability	0%	30%	45%	25%
Scientific inquiry skills	0%	0%	37%	63%

During the focus group, the Solano teachers discussed that it was difficult to do outdoor activities with the students. Some of these teachers did have some type of creek or water near their school, but the logistics and time to take the students outside and do the lesson would be difficult. They felt there was not enough time in a class period. Two teachers discussed having some optional fieldtrips for the students on weekends as a way to get students doing outdoor activities. These teachers also discussed doing labs in the classroom. In regards to labs, one teacher discussed some water testing in the classroom and had students bring in water samples from the area. Also this teacher did a lab that tested the soil. This teacher did labs, but said that the number of students in the class keeps increasing so there are safety concerns in doing a lab. As a result of these increasing numbers, one of the teachers no longer did any hands-on activities and mainly worked through the textbook and used online resources. In addition, these teachers felt much pressure to cover a certain amount of material by the time of the state test. The teachers had a pacing guide of how many days they could spend on each topic. If the students did not understand a topic, there was no time to go back and spend more time. The pacing guide also limits the amount of time to explore a particular topic.

All of the teachers responded to a survey question about the kinds of experiential

opportunities the students are provided with as part of their classroom experience. Several of the teachers in Solano County discussed that in the past there were more outdoor activities, but because of budget issues and testing, this does not happen very often. One teacher said, “Let the kids outdoors, off campus? Are you crazy? They don't let us do that! That costs money which we don't have and takes away from time spent on standardized test prep. We are specifically prohibited from doing that.” Some of the teachers in Solano County still are providing outdoor experiential opportunities for their students. These opportunities include:

- Activities that can be done on campus such as monitoring weather conditions or climate
- Recently got access to a creek near campus, but have not incorporated yet
- LiMPETS
- Field hikes
- Hikes at state parks observing native versus nonnative plant species, weed pulling, astronomy camping trip, visiting farms, outdoor campus environmental projects- trash, weeds, water usage
- Walk to local creek to gather water samples
- Local creek cleanup and water quality testing
- Beach clean ups
- Adopting a watershed
- School storm water quality survey
- Take oceanography students on one field trip
- Field trip to Catalina Island for advanced students
- None during class time sometimes have field trips on weekends
- Students are made aware of some the local opportunities

During the focus groups in Marin County, many of the teachers discussed that their schools were near creeks or water areas and they took their students outside to do various experiments or to learn about the area. One teacher also discussed having a big garden and the students collected data over the school year on the soil moisture, soil temperature, nitrogen content, and many other variables. Another teacher discussed as part of the San Francisco Bay unit the students choose an aquatic site and they need to visit the site once a week to learn about the organisms, impacts, mapping, and the changes over the season. The teachers discussed that it is difficult to take a class on a fieldtrip because of all the paperwork, the logistics in organizing the trip, and the students miss their other classes. Funding was less of an issue in going on a fieldtrip. Several teachers discussed the strong emphasis that is placed on the scientific method and that the students have opportunities to collect their own data and analyze it. Students do experiments both in the classroom and outside. Two teachers (from the same school) discussed that the science fair is required in tenth grade so the teacher supports students doing research and collecting data.

All of the teachers responded to a survey question about the kinds of experiential opportunities the students are provided with as part of their classroom experience. Most of the Marin County teachers had some type of outdoor experiential opportunity that they listed. Two teachers said that they did not do much. The outdoor experiential activities

that the Marin teachers listed included:

- Observation of ecosystems on campus
- Campus data collection
- Around the local campus, which does not have a lot of natural areas to focus on
- Water quality testing
- Observing school garden
- Garden work
- Soil analysis
- Plant walks/surveys
- Creek monitoring
- Survey of biotic and abiotic factors in the surrounding estuary
- Field study of local aquatic system
- Couple days out in the marsh collecting data
- Wetland labs
- Marine Science Institute
- Field trip - boat on the bay collect water samples, bottom trawl, etc.
- Muir Beach restoration
- Sandy beach monitoring (Muir Beach)
- Rocky intertidal (Bollinas)
- Salt marsh visit (Larkspur)
- LiMPETS (100+ kids)
- Monitoring with LiMPETS program (Gulf of the Farallones Marine Sanctuary)
- Field trip - Duxbury reef to collect data for LiMPETS
- Water treatment
- Field trip to recycling center
- Air pollution data collection
- Biodiversity study (Shannon-Weaver Diversity Index)
- Going on short hikes to local parks
- Tresch Dairy farms (local organic farm that makes Straus milk)
- Non-native plant species removal with MMWD
- Couple days devoted to local program of invasive removal and native planting
- Field study project as part of the San Francisco Bay unit

Web resources and science data streams utilized in the classroom

The teachers responded to a question regarding the web resources they use to find information on estuary-related topics. Table 8 presents the percent of teachers that utilize each of the resources for both Solano and Marin Counties. The teachers that listed National non-profit as a web resource listed: ACES – Signals of Spring (a NOAA-funded project), Monterey Bay Aquarium Sustainable Seafood, and a variety of resources. The teachers that listed Local non-profit as a web resource included: Save the Bay, Bay Institute, Wildcare, Bay Report Card, and others. There were also teachers that listed other web resources. These resources included: general Google searches, periodicals and newspapers, KQED Quest, Romberg Tiburon Center, Science magazine, and Farallones Marine Sanctuary. One teacher commented about not using online resources very much

for this purpose, but probably should start using these resources.

Table 8: WEB RESOURCES USED TO FIND INFORMATION ON ESTUARY-RELATED TOPICS

Web Resources	Solano County	Marin County
National Oceanic and Atmospheric Administration's Education Website - http://www.education.noaa.gov	55%	55%
National Estuarine Research Reserve System's Website - http://nerrs.noaa.gov	5%	0%
National Estuarine Research Reserve System's, Education Website – http://www.estuaries.gov	5%	0%
San Francisco Bay National Estuarine Research Reserve's Website - www.sfbaynerr.org	9%	15%
California State government Website - http://www.ca.gov/	32%	10%
National Science Teachers Association's Estuaries Sci Guide - http://sciguides.nsta.org	9%	5%
Environmental Protection Agency's Education Website - http://www.epa.gov/enviroed/	23%	20%
Wikipedia - http://wikipedia.org	18%	45%
National non-profit	5%	10%
Local non-profit	0%	15%
I do not use web resources	23%	5%
Other	14%	25%

The teachers responded to a question regarding real-time data stream that they access or use in their teaching. Table 9 presents the results for both Solano and Marin Counties. The top seven responses in Solano County included none of the above, atmosphere carbon dioxide, temperature – air, temperature – water, algal blooms, currents, and salinity. In Marin County, the top eight responses included none of the above, atmosphere carbon dioxide, temperature – water, temperature – air, animal tag/tracking, pH, sea level rise, and water depth. Two teachers listed other data streams they utilized in the classroom that included atmospheric pressure and toxins in the water.

Table 9: SCIENCE DATA STREAMS UTILIZED IN CLASSROOM

Science Data Streams	Solano County	Marin County
Algal blooms	20%	6%
Animal tag/tracking	15%	17%
Atmosphere carbon dioxide	30%	28%
Bathymetry/topography	5%	6%
Currents	20%	11%
Dissolved oxygen (DO)	10%	11%
Fish species & abundance	15%	6%
Nutrients	10%	11%
Ocean color	5%	6%
pH	15%	17%
Salinity	20%	11%
Sea level rise	15%	17%
Temperature - air	25%	22%
Temperature - water	20%	28%
Water depth	15%	17%
Water contaminants	5%	11%
Water turbidity (clarity/cloudiness)	5%	6%
Waves	10%	11%
Zooplankton species	10%	6%
None of the above	45%	56%
Other (please specify)	10%	6%

Professional Development Experiences

The teachers responded to a variety of questions related to their professional development experience both in the survey and in the focus groups. We asked teachers about the amount of professional development training in estuary-related topics they have had, their professional development support, what types of professional development programs they have participated in, and also whether education units or professional learning units had importance in deciding professional development opportunities.

The data in Tables 10 and 11 reflect the amount of hours of estuary-related professional development training the teachers have had in the past three years in Solano and Marin Counties. In both counties a majority of the teachers have had no estuary-related professional development training. In Marin County, about half of the teachers have had some type of ocean-related training.

Table 10: HOURS OF PROFESSIONAL DEVELOPMENT TRAINING IN ESTUARY-RELATED TOPICS – SOLANO COUNTY

Hours	Estuaries	Watershed	Ocean
None	82%	77%	82%
Less than 8 hours	5%	9%	5%
8 hours (1 day)	0%	0%	0%
9-16 hours (2 days)	9%	9%	5%
17-24 hours (3 days)	0%	0%	5%
25-32 hours (4 days)	0%	0%	0%
33-40 hours (5 days)	0%	0%	0%
More than 40 hours	5%	5%	5%

Table 11: HOURS OF PROFESSIONAL DEVELOPMENT TRAINING IN ESTUARY-RELATED TOPICS – MARIN COUNTY

Hours	Estuaries	Watershed	Ocean
None	67%	76%	52%
Less than 8 hours	19%	14%	24%
8 hours (1 day)	5%	0%	5%
9-16 hours (2 days)	10%	10%	5%
17-24 hours (3 days)	0%	0%	10%
25-32 hours (4 days)	0%	0%	0%
33-40 hours (5 days)	0%	0%	0%
More than 40 hours	0%	0%	5%

During the focus groups, we had some discussion about support for participating in professional development. The previous data reflects that the teachers have had very little training in estuary-related topics. However, based on the focus groups it was discovered that the support for professional development was very different. In Solano County, the teachers discussed how science teachers basically do not have any support in professional development training. The schools support the language arts and math programs and if there is any money left over it is divided among the rest of the programs. As a result, science gets very little financial support for training. Some of the teachers discussed that on their own they were teaching themselves, were taking some classes, or looking for information online. They also thought there were limited opportunities or places to get information in their county. They said that UC Davis has a program, but it starts before teachers finish the school year.

In Marin County, the teachers felt that their schools had much more support to participate in professional development trainings. The teachers felt support was influenced by the state of the budget, but in general the administration supported teachers. They said sometimes it was difficult to find substitutes. Many of the teachers thought time was more of an issue than the money. Some of the teachers discussed how their district has a certain amount of professional development days built into the school year and that they would probably support having some kind of day-long training on estuary-related topics especially since it would fit with their San Francisco Bay unit. These teachers also felt there were a fair amount of resources available to get information about estuary-related topics. They thought some of the difficulty involved knowing where to find this information.

The teachers responded to the types of professional development trainings they have participated in to supplement their education. Table 12 displays the percent of teachers who participated in various programs for both Solano and Marin Counties. The teachers also included some of the other programs. The teachers in Solano County said the Teacher Enhancement Program (TEP) at the Moss Landing Marine Laboratory, the bay model visitor center training program, Solano County of Education, programs through Marine Sanctuaries such as Animals in Curriculum-based Ecosystem Studies (ACES), programs through Bay Area Earth Science Institute (BAESI), San Francisco State Master's Program courses, and individual study/research project with tide pools. In Marin County, the responses included: PolarTREC, Toyota International Teacher Program to the Galapagos, Advanced Placement Environmental Science training by the College Board, Surfrider Foundation, Science magazine, Farallones Marine Sanctuary, Save the Bay, Romberg-Tiburon volunteer, National Marine Fisheries Service (NMFS), and Voices of the Bay.

Table 12: PROFESSIONAL DEVELOPMENT TRAINING PROGRAMS – SOLANO AND MARIN COUNTIES

Professional Development Training Programs	Solano County	Marin County
NOAA/NERRS Teachers on the Estuary Training	5%	5%
Project WET	18%	19%
Project Wild Aquatic	5%	10%
Green Eggs and Sand Workshop	0%	0%
The Jason Project Professional Development	0%	19%
Long-term Monitoring Program and Experiential Training for Students (LiMPETS)	14%	29%
None of the above	64%	38%
Other	23%	33%

Teachers responded to whether continuing education units and/or professional units were important in their participation in various professional development trainings. Table 13 displays the data that includes the percent of teachers that thought the units were important. The results indicate that in both counties that the units are not that important for most teachers in whether they participate in the professional development trainings.

Table 13: IMPORTANCE OF CONTINUING EDUCATION UNITS AND/OR PROFESSIONAL UNITS FOR TEACHERS' PARTICIPATION IN TRAININGS

County	Continuing Education Units		Professional Learning Units	
	Number of Teachers	Percent of Teachers	Number of Teachers	Percent of Teachers
Marin County (N = 20)	4	20%	3	15%
Solano County (N = 22)	7	32%	5	23%

Current Experience with the NERR-type Programs and Resources

Few of the teachers discussed the NERR or the NERR-type programs as part of their current teaching or as part of their professional development. The teachers answered some more direct questions about their awareness of the Reserve and whether they have used any of the educational services or products. Table 14 reflects the data on teachers'

awareness of the Reserve. In Table 15, the data shows the teachers who said they had an awareness of the NERR and if they have ever used any of the educational services or products. Most of the teachers were not aware of the San Francisco Bay NERR and as a result very few are using the services and products. The teachers' experiences with the educational services and products included one person trained to be a volunteer docent at Rush Ranch and another was a research biologist that did some work at China Camp. Some of the teachers who said they did not use the services said they were unaware, never thought to look, it was not easy to access, it was hard to apply it to high school chemistry, and it does not pertain to the immediate needs of the students (the need to prepare students for the state exams).

Table 14: TEACHERS AWARENESS OF SAN FRANCISCO BAY NERR

County	Yes	No
Marin County (N = 20)	35%	65%
Solano County (N = 22)	18%	82%

Table 15: TEACHERS AWARENESS OF SAN FRANCISCO BAY NERR WHO USE EDUCATIONAL SERVICES AND PRODUCTS

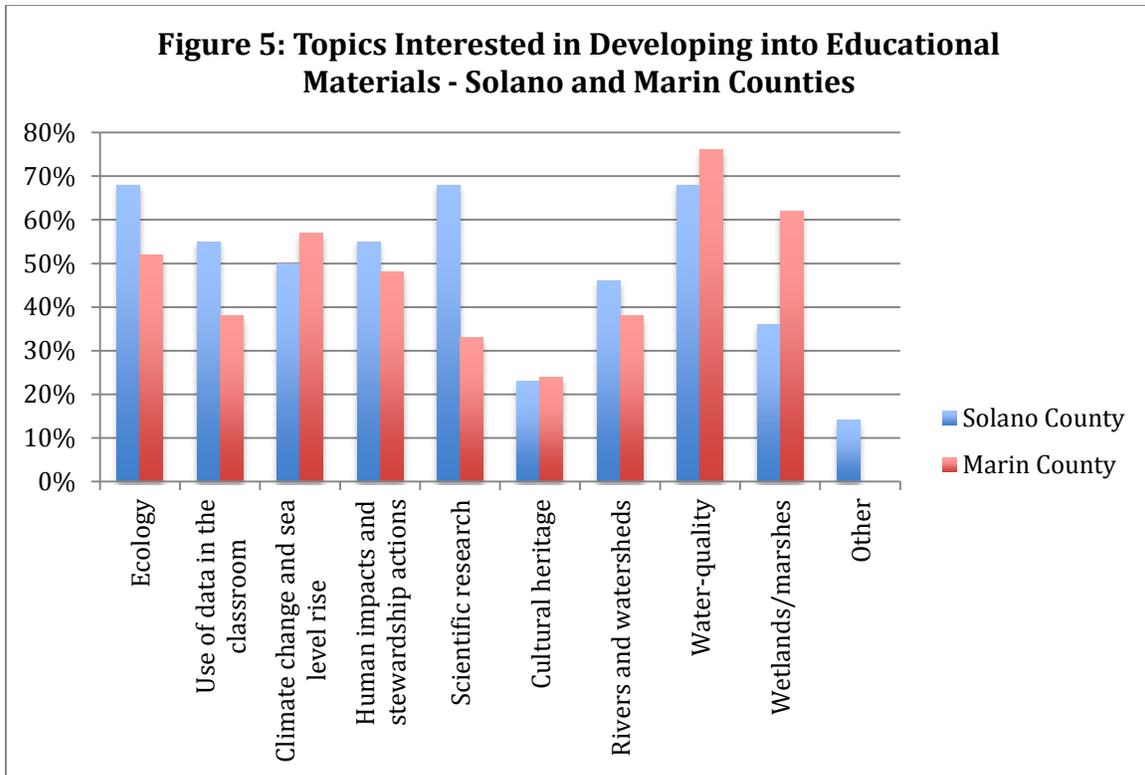
County	Yes	No
Marin County (N = 7)	0%	100%
Solano County (N = 4)	25%	75%

NERR Possible Support, Programs, and Professional Development

The teachers responded to a variety of questions relating to possible areas where the NERR could be helpful and supportive. We asked teachers about possible topics of interest, professional development, real time data sets, outdoor education, climate change, and other types of support.

Topics of interest

In Figure 5, the data reflects the types of topics that the teachers would like to see developed into educational materials. The data is presented in more detail in Appendix C (Table 3C). Many of the teachers said they were interested in most of the topics listed. The topic that was of least interest to both counties was cultural heritage. In both counties, water quality seemed to be of high interest. A few teachers in Solano County had other topics that included: importance of the local habitat on students' lives (water, health, economy) and sources of water. One teacher in Solano County said "none of these would fly as they do not meet the needs of the students for AYP [Adequate Yearly Progress] or API [Academic Performance Index]."



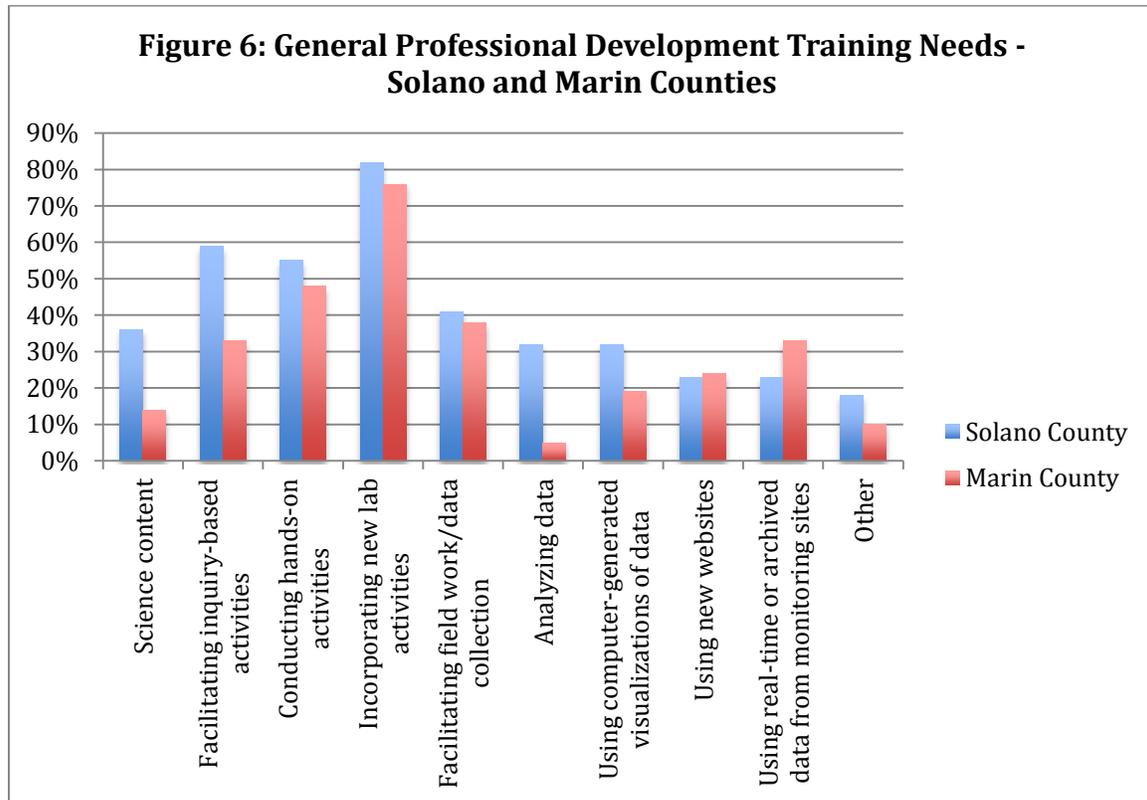
During the focus groups, some of the teachers discussed more specific areas and topics where they would like to have more support or educational materials. The Solano County teachers included sources of pollutants and its impact on wildlife, what environment would look like if pristine, how does pollution fluctuate in a given year, bigger questions for students (“Why do they live here?” and “What makes it so they can survive?”), toxins and how they are tested, areas that are topical or of current interest, water quality, and how science relates to students’ lives. One teacher felt that high school is the last chance to get students interested in science before college so they need more involved projects that relates science to their lives.

The teachers in the Marin County focus groups responded: doing more political-type discussions (i.e. how the students can have an impact on change in the Bay), dam control, fishing and recreation impact on the Bay, water quality monitoring/numbers, impact of humanity on Bay (population, copper content, etc.), climate change, overview about Bay/Estuary, biology of the organisms living in the Bay, and habitat restoration.

Professional development support

The teachers responded to a few questions regarding the types of professional development programs that they would find helpful and would likely attend. Figure 6 displays the general types of professional development training the teachers felt they needed. The data is presented in more detail in Appendix C (Table 4C). In both counties, the largest group of teachers felt that they would like support in being able to incorporate new lab activities. In addition, in Solano County a large percentage of teachers would like more support with facilitating inquiry-based activities. Some of the teachers also included

other training needs that included: fitting materials learned in training in the current curriculum, new protocol training to use equipment, using technology in the classroom, and exposure to fields of science where there is less familiarity.



The teachers discussed specific types of professional development programs they would find helpful. The Solano County teachers' responses included:

- Workshops that tie to the state content standards and allow the teacher to bring activities to the classroom that are easily relatable to issues students will encounter in lives
- Have to clearly align with state standards for biology and not be a long unit
- Content-based professional development is critical to classroom teachers and if there is not a distinct correlation, the professional development is not as useful
- Workshops directly related to the content required by the College Board for AP Environmental Science
- Explore all options because teaching a new AP Environmental Science class which will tie more directly to these topics
- Any topic
- Training to present the information using inquiry-based activities that can be done in the classroom
- Workshops that provide hands-on activities training that can be brought back to the classroom easily
- Programs that relate to current topics and involve hands on instruction
- Region-specific programs would help students relate to the material more

- Interactive maps using computers
- Local field trips kids could go on or that the teacher can attend to bring samples back to the classroom for study
- Current research/current events in a seminar setting
- Something that would integrate chemistry
- Professional development related to the chemistry aspect of watersheds would be useful.
- Do acid/base labs in Chemistry, so some type of real life application would be helpful
- New labs for students that are inexpensive

The Marin County teachers included the following responses:

- Labs that can be applied directly into the classroom and correspond with California High School Science teaching standards for Earth Science or Biology
- Step-by-step training of applications of existing content in estuary-related inquiry
- Anything that relates to the estuary-related topic
- Background on estuary-related topics specific to the San Francisco Bay
- During one of the district training days, have a full day of workshops and lectures on estuary-related topics related to the San Francisco Bay
- High level, hands on labs aimed at 11th and 12th graders only
- Professional development designed for high school teachers
- No substitute for fieldwork and want to get out on the water and then bring as many students as possible
- Follow a scientist into the field such as into a marsh
- Data collection on the Bay
- Learn how to monitor the water ways around San Rafael High school both with Honors Chemistry students and Physical Science students
- Currently teach chemistry so if there were a way to work in meteorological data and water chemistry in (real-world data) and also partner with a lab to have students involved in long term monitoring
- Larger-scale data use/analysis to incorporate what has been done and link to a small study or experiment that the students do themselves
- Attend something that will introduce new labs, activities and other hands on techniques to class
- Want to be able to use the materials/information learned at a workshop with classes because it is hard to find the time to write new activities or greatly modify activities learned workshops
- Shadow another teacher to learn about how they do an activity
- Something incorporating action or technology
- If there is a "new" location with financial support that opens up to those that are trained, would get the training to get the funding/use of tools/research location

Supporting teaching with real time data sets synthesized into learning materials

Table 16 displays results for both Solano and Marin Counties about what topics teachers would like data sets synthesized into learning materials. A few teachers listed some other

topics that included ones for freshman, some for Marine Science, some for Advanced Placement Environmental Science, and some for the location of plastics in the ocean (Pacific Gyre size, amplitude, and location).

Table 16: REAL TIME DATA SETS SYNTHESIZED INTO LEARNING MATERIALS – SOLANO AND MARIN COUNTIES

Real Time Data Sets Topics	Solano County	Marin County
Algal blooms	40%	60%
Animal tag/tracking	25%	25%
Atmosphere carbon dioxide	65%	55%
Bathymetry/topography	10%	25%
Currents	30%	35%
Dissolved oxygen (DO)	50%	45%
Fish species & abundance	45%	50%
Nutrients	40%	60%
Ocean color	15%	10%
pH	65%	40%
Salinity	50%	50%
Sea level rise	45%	55%
Temperature - air	35%	45%
Temperature - water	40%	45%
Water depth	25%	15%
Water contaminants	45%	35%
Water turbidity (clarity/cloudiness)	40%	40%
Waves	5%	20%
Zooplankton species	20%	45%
None of the above	20%	5%
Other	0%	10%

Support incorporating outdoor education in your classroom

The teachers responded to a question regarding what kind of help they would need to incorporate more outdoor education in their classrooms. Table 17 displays these results for both counties. In Solano County the largest group of teachers said they felt facilitating inquiry-based activities would be the most helpful and in Marin County facilitating field work/data collection was viewed as being the most helpful. Several teachers included other suggestions of areas that they would like more help in incorporating outdoor education. The Solano County teachers responses included models, posters, and ideas on how it can be incorporated into the curriculum in a moderate amount of time, and something short that would last one or two days. Several other teachers discussed that money and transportation would be an issue with these types of activities. One teacher said “My students are not far enough along in their basic chemistry training to even name compounds let alone explain the interaction of salt with the biological systems.” In Marin County some of the other responses included someone to work with, making these activities suitable to 50+ students in high school, advanced level trainer and equipment [like LiMPETS], and examples of what teachers are doing around the region.

Table 17: SUPPORT INCORPORATING OUTDOOR EDUCATION IN CLASSROOM – SOLANO AND MARIN COUNTIES

Support Activities Incorporating Outdoor Education	Solano County	Marin County
Unstructured outdoor experiential activities	9%	26%
Backpacks with field guides, binoculars, magnifying glasses and activity guides, among others	27%	11%
Facilitating inquiry-based activities	68%	37%
Conducting hands-on activities	55%	53%
Guidance on monitoring activities	36%	42%
Facilitating field work/data collection	55%	79%
Other	32%	21%

Support incorporating discussion about climate change in your classroom

The teachers answered a free-response question about incorporating climate change in their classrooms. In both counties, several teachers discussed data sets and access to data being helpful to support discussion about climate change. The Solano County teachers included the following responses:

- Data sets that students could use to develop their own models to explain the phenomena
- Data relating to local areas
- Easier access to local research, data sets, etc.
- Real world data
- Online data to analyze
- Data collection
- Lesson plans
- Need curriculum in this area
- Information related to the curriculum
- Cross curricular activities so students see materials across disciplines and see how it's related
- DVD
- Maps
- Classroom resources. School relies on online resources (primarily NOVA)
- Specific case studies. Students who are given general information don't incorporate the information as well as if it were presented in the context of a story or event
- How does this relate to basic chemistry needed for college entrance tests?
- Need more direction on how chemistry standards can be incorporated
- Equipment
- Professional development

The Marin County teachers' responses included:

- Data
- Current research and results
- Aggregated data source
- Set of current data ...i.e. Bay Level changes...insect hatching...etc.

- More information on research projects that are current, how the data or results were being used i.e., new legislation regarding fisheries management, water usage in the state, etc.
- Background knowledge
- Existing lesson plan that has worked before
- Activities
- Less discussion more experience followed by reflection from what they experienced
- Maps and mapping programs that visualize
- Visual representations of projections for sea level in X years
- Media materials about the impact of climate change and the chemistry of this climate change as it applies to the SF Bay Area
- PowerPoint slides in class with pictures and data from the local area
- Controversial topic in school, believe it or not
- Ways to convince the community that one very vocal teacher's overt skepticism shouldn't be driving whether this issue is addressed

Other types of support

During the focus groups and in the survey the teachers also discussed other types of programs, such as trainings, field trips, educational materials, etc. where NERR could be helpful or supportive. In both counties, many teachers expressed interest in field trips and also having programs related to learning about data collection and sampling in the field. However, a number of teachers were concerned with the cost of a field trip and getting a substitute. The Solano County teachers said the following:

- “Making field trips available for students would be huge. I used to take the Honors Chemistry students out on a boat on the bay to collect data and water samples that they would test and record the results for real researchers. The cost was high, but students did fund-raising to cover much of it. Then the company decided we came from too far away and would no longer subsidize us as they did closer schools and the cost became prohibitive.”
- Field trips would be a tremendous support in order to help teach students
- Field trip to Suisun Marsh
- Sampling in the field: Previously came back and processed the benthic samples and entered the data in a public database
- Support with data collection in a watershed would be useful
- Probeware might be useful to go and remotely collect data
- Students find it difficult to collect data, a program that could better support student data collecting techniques
- Programs in the County that can handle a large number of high school students
- Have someone either visit the school or meet at a site
- Programs at the school site would be useful
- Material about career opportunities in these fields would show the students how they could become involved
- Educational materials focused on the Bay Area water sources
- Clean up efforts to remove toxic chemicals or oil spills

- A database of current research would be invaluable to having students work with data sets, case studies, articles, etc.
- Educational materials, lessons or teachings modules that relate to content standards would be beneficial
- The only programs that can be taught here are ones that relate to the increase of the AYP or API and that is Math and English and core subjects associated with the NCLB [No Child Left Behind]
- Funds for transportation for field trips and funds to provide substitutes
- District support to attend programs during the school year

During the focus group in Solano County, the teachers discussed several areas where NERR could be supportive. The teachers said they would like to have more access to data and various databases. Some of the databases included water chemistry, where phosphates are coming from, where nitrates are coming from, and other water quality databases. They also thought some common databases where schools could share data and collaborate would be very useful. Another area of discussion involved the inadequate number of sample collection kits for students because of funding issues. The teachers thought it would be useful to have access to a library-type system where schools can check out and borrow various collection kits. These teachers also felt having guest speakers and hands on activities in the classroom would be much more possible, because of the lack of funds and the difficulty in doing field trips. Currently, they only have optional field trips on the weekends that are not well attended. These teachers said they would like to be able to organize bigger field trip with more resources, teachers, stations, etc. All the field trips need to be less than 30 minutes away from the students' houses. One idea to increase participation at these field trips is to have a special guest speaker at school first to get the students interested in coming to the Saturday fieldtrip. These teachers also suggested GeoQuesting at Rush Ranch and a travelling trailer with a display of items related to the bay and estuary-related topics.

The Marin County teachers' responses included:

- Field trips
- Field trips out on the bay
- Go out on the bay using a plankton net, sediment corer, CTD, etc. School could help pay for it, just need access to the right vessel/program
- Like MSI. . hands on research on/near the SF estuary; salt marshes and research opportunities for students (high school juniors and seniors. . . able to drive!)
- Get students out in the field collecting data over a long period of time starting after the STAR test in late April/early May
- Supporting student data collection outside of school
- Site based programs using the resources near school
- Local experts to work with our students in field work and in classroom relating to salt marsh behind school as well as other sites.
- Guest speakers; lab tour where folks do real ocean chemistry research would be cool.
- Have projects that are suited to a large number of students

- Trainings, supporting students, collecting data, field trips, educational materials, etc., especially if it came with a grant and equipment use

During the focus groups in Marin County, the teachers talked about several other areas where NERR could be helpful. They discussed how a Clearinghouse website would be helpful where teachers could tap into different organizations and know what teachers are doing locally that have been successful. Also a website that gathers all the data and information about the Bay together. A second idea included letting more teachers know about NERR's website and what is going on with NERR (i.e. research, talks, events, etc.) possibly through teachers subscribing to an email list. Teachers could also learn more about the organization if NERR donated its completed science posters to schools. Another idea included having outside speakers about a specialized topic, possibly interns or undergraduates, come to the classroom. The students then could possibly work with these interns in the field and do mini-studies to learn more about a scientist's job. There could also be opportunities for students to do longer-term internships with scientists. One of the schools had a science fair requirement and thought it would be helpful to have the students have a scientist sponsor (help choosing a topic, provide tools, help collect data, etc.) while the students are working on their projects. The teachers also discussed having the professional development opportunity to spend time with the researchers and scientists and to visit China Camp and the Romberg Tiburon Center to learn more about the bay and the research that goes on in the bay. The teachers said that Tamalpais High School District has a San Francisco Bay course that was created about ten years ago and they would be open to new activities and curriculum to update this course. Many of these teachers discussed that fieldtrips are difficult because students have to make up work and the amount of paperwork.

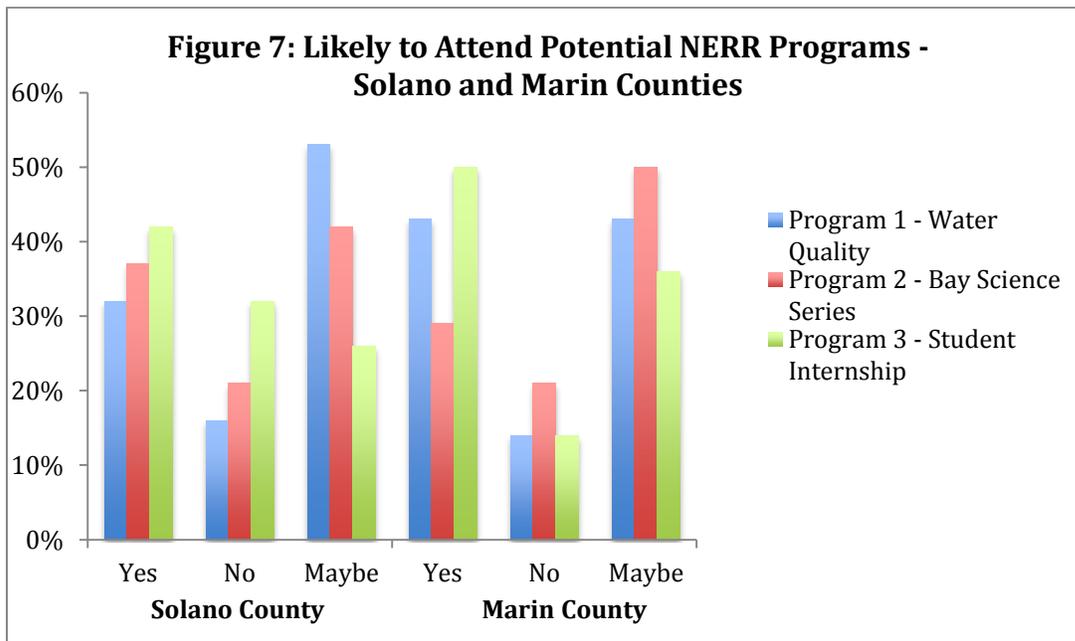
The teachers responded to whether there is a need for the various educational materials at the NERR to be developed in different languages (See Table 18). Most teachers in both counties did not see a need to develop the materials in different languages. The teachers that did feel that the materials should be developed in other languages said they should be in Spanish (6 teachers in Solano County and 2 teachers in Marin County), Tagalog (1 teacher in Solano County), and Chinese (1 teacher in Solano County). One teacher felt that there should be Spanish materials for families that live right near the wetlands/bay.

Table 18: NEED FOR ESTUARY-RELATED EDUCATIONAL MATERIALS TO BE DEVELOPED IN DIFFERENT LANGUAGES

County	Yes	No
Marin County	16%	84%
Solano County	33%	67%

Thoughts about Possible NERR Programs

Sarah Ferner, the education coordinator at NERR, had ideas of some possible programs that could be developed. The teachers answered questions on the survey and during the focus groups about their thoughts and impressions about these programs. Figure 7 presents the likelihood that teachers would attend each of the NERR programs. In the subsequent sections is a discussion of the results for each program including the teachers' thoughts and suggestions.



Program 1: Water quality monitoring throughout the watershed

The teachers responded to whether they would likely attend this program and their thoughts or suggestions about this program. The teachers overall were enthusiastic about this program, but it seems that many teachers felt there would be hurdles in trying to implement it. That is reflected in the teachers' responses and also the large number of "Maybe" responses.

Thoughts and suggestions by Solano County teachers include:

- "Wonderful! Can't wait to participate!"
- "I love the idea of doing some monitoring with the students. They learn about this presently from a video. Unfortunately, the barrier presently is the funding."
- "This would be an excellent way for the students to do meaningful research and feel a part of their local environment."
- "This would be nice to use in my chemistry class to show applications of how water samples are tested for specific chemicals and to calculate concentrations"
- "It could be difficult to get funding and approval for field trips with students"
- "If it was in Suisun marsh, yes, but further away would require too much travel time and would be good for a small group, but difficult to get supervision for all of my classes to attend. I would love to be able to take a small group of students, but at the high school level it would be hard to take all 150 students on a field trip. It would be nice to have the experience, but I don't know how to organize something like this for such a large group of students."
- "High school students can't miss too much class time. Would we be able to bring all of our sections on the same day? If we can't then there isn't enough money to cover a sub. I LOVE that we would have access to additional data. Sometimes there can be so much that it is difficult to sort through. It would be great if there

was also some historical data correlating to specific events - such as rainstorms, exceptional tides, etc. that was already set aside so that we can build activities around that as well.”

- “It is a wonderful program, however, it would not meet the guidelines of IB Biology, nor the regular Biology course outline as stated by the State, as far as I can read...”
- “It sounds wonderful. The problem is the biology curriculum is already jam packed compared to the amount of time available.”
- “UC Davis extension and Fairfield-Suisun Sewer District have already produced a Curb 2 Creek program and a Sewer Science program which details the some of the same information about water sheds and water use. Megan Harns at UC Davis has been my contact for this.”
- “Pros: Access to data, hands on. Cons: not related to curriculum”
- “If I knew the correlation to the state standards for the course that I teach, I would be more inclined to participate.”
- “I would want to talk with teachers who have been involved with the program to find if the program could include a heavy chemistry angle.”
- “The tricky part would be transportation for the students even across town and providing substitutes for my other classes while we were gone. I could trade out prep periods for occasional absences, but too many and I would not be able to go.”
- “Sounds good but only the end of the school year is given to acid/base concepts”

The Solano County teachers that participated in the focus group had some feedback about this program. Overall, they liked the program. One teacher thought, it would be possible to do part of this program because it would be difficult to do it during class time because of the short time period and the distance to the creek. This teacher thought that students could collect the data afterschool or on weekends. It would take some persuasion, but the students would enjoy it.

Thoughts and suggestions by Marin County teachers include:

- “Sounds exactly what we would want to be able to do, including service component, citizen scientist component, and avenue for developing content and skills knowledge.”
- “Sounds great! We have a semester project each semester wherein students do hands-on work. . . this would be wonderful!”
- “Do a pre-questionary of teacher background so training can be based on prior knowledge or sorted by need of attendees”
- “Difficulty getting Freshmen to the creeks”
- “Drake High School already has an in-house program (SEA-DISC) for Juniors and Seniors that does this. I teach the younger grades, and would be reluctant to step on SEA-DISC's turf.”
- “We already monitor our local creek which feeds into Corte Madera, but our data is not used, so it would be nice if it was. But sometimes we haven't participated in data programs if they require us to collect too many times a year. As teachers do a unit and then need to move on to new topics.”

- “Again. There needs to be differentiation between grade levels.”
- “I would want to make sure ahead of time that I could apply what was being presented to an Honors Chemistry level student and that I could work with 50+ students on the lessons.”
- “Getting my students out of class and to the location would be a challenge. I would also want to do it with all of my classes, but that would be 120 students - a bit much to do field work with!”
- “It sounds interesting, but may be difficult to find the time to do it justice in an intro biology class.”
- “The biggest issue would be to find the time within my class to incorporate it, although it sounds like a great idea.”

The teachers that participated in the Marin County focus groups were very positive about this program. This was the program that the teachers discussed the most and they seemed excited about it. These teachers did not discuss many hurdles associated with this program as compared to the Marin County teachers who took the survey. They liked how this program had a data piece that involved monitoring data and how the students were involved in that process. With this program they thought that an added component could be that older kids can collect data for younger kids to analyze and so the data will carry over from year to year. Also they were interested in whether water quality matters more at different times of the year and looking at canal-based information. One teacher felt this program might work better and be more manageable if do with a smaller group of students selected by grade or interest and possibly nominated by teachers. The teachers in Tamalpais High School District felt this program could possibly be implemented and integrated easily into their established San Francisco Bay course curriculum. That would make it easier for the teachers and they would be more excited about doing it. Teachers are interested in improving their practice, but it helps when make things easier for them to implement. Also almost all the schools in this area have water near by which makes this program easier to implement.

Program 2: Bay science series for teachers

The teachers reported their thoughts about attending the science series for teachers. The results indicate a smaller percentage of teachers said that they would attend this type of program and about half the teachers said they might attend. The teachers in Solano thought that the program sounded interesting and liked that there was the potential of earning a stipend if they participated. The biggest concern with this program was the time commitment and whether the talk would cover material in the state standards. Marin County teachers seemed less enthusiastic about the program, but they liked the stipend as well. Several teachers felt they knew the content and wanted more help bringing the students in the field.

Thoughts and suggestions by Solano County teachers include:

- “This sounds great!”
- “I like the idea of getting up to date information on our local environmental issues. This fits well into our present program - water quality and climate change.”

- “Like the opportunity to work collaboratively with other science teachers and increase my personal knowledge of the subject.”
- “Pros: field research experiences, stipend for research materials for classroom”
- “I like hearing about current research and talking with the scientists themselves. I don't need the CEUs but the stipend might be useful.”
- “Knowing more about the ecology of the tidal marshes seems most applicable to the course that I teach, however, there may be topics that will also fit within the state standards.”
- “I LOVE that there will be money for supplies for the classrooms. If we get great ideas, but can't implement them, then the class loses much of its impact. I don't need units anymore, but I know lots of teachers do, so I think it's great that you are building that component in.”
- “This sounds very interesting. Not sure if I would be able to commit the time to it though.”
- “This series seems as if the time commitment would be larger than what I should take on due to other commitments.”
- “Sounds interesting, but more of an Biology or Envir Sci approach.”
- “Depends on when the classes are held as to whether I would be able to attend. Marsh ecology isn't part of the state standards and there isn't much time to teach anything outside of state standards anymore :(”
- “This is really a JC or college course...would not fly at my school.”

The teachers that participated in the Solano County focus group liked this program as well, but they did not say much during the discussion.

The Marin County teachers' thoughts about the second program include:

- “Sounds like what the SFSU RTC has done, combined with what CalAcad used to do. Love it.”
- “I would love to have guest speakers in April and May and would love to have them present at all chemistry classes.”
- “Don't need the credits, but stipends are always helpful!”
- “This sounds interesting, but I already have experience with these realms and would not make a priority to attend something like this.”
- “I already know a lot of the content - I just need help getting my students out on the water so they can experience it for themselves.”
- “Sounds like it would involve a lot of time, can't really attend training that has multiple meetings”
- “I would prefer the stipend or a grant to purchase site equipment/tools”
- “I'd like to see more labs that can be applied directly to the classroom.”
- “We don't spend a lot of time on estuaries”

The teachers from Marin County that participated in the focus groups thought at a general level the program sounded good. One teacher thought it would be helpful to do activities that could be brought back in to the classroom and done with students. The concern with this program is the teachers finding time to participate.

Program 3: Estuary science internship for students

The teachers responded to their thoughts about a possible program that involved students having an internship in estuary science. The results indicate a higher percentage of teachers that felt that they would be more likely to participate in this program than the two other programs. In Marin County, there were a much higher percentage of teachers who said they would or might participate than in Solano County. In Solano County, many of the teachers were excited about this program and felt it may be good for Honors Students or ones interested in becoming a scientist. The main concern was student transportation to the internship. In Marin County, many of the teachers seemed very excited about it and many said they already have an internship program in place for students and this would be a nice addition to that program. The main concern in this county was students having the time to participate. This program takes very little teacher time in comparison to the other two programs that may be one explanation why more teachers felt positive about this internship program.

The Solano County teachers' responses include:

- “I would be happy to recommend students for a watershed internship.”
- “This would work well with our environmental science program”
- “Providing such opportunities to students would be fantastic! We have some outstanding candidates for such a program. Since we are in Solano County, Suisun Marsh research would be relevant and doable.”
- “This suits the needs of our honor students. They would be very enthusiastic about this opportunity.”
- “I would recommend this to many of my honors science students who are doing research for their science projects. They would really like having a mentor to help them collect data and analyze it. This sounds like an excellent program for students who are interested in a deeper understanding, that can't be covered in class.”
- “Excellent way to start students on the path to a career.”
- “However, it is possible that some of my students would be interested.”
- “I may be able to participate, dependent upon the time requirement. This program seems like an exciting option for some of our students who are dreaming of a career as a research scientist.”
- “Wonder if this is for high school or middle school students”
- “It would just depend on my students. Some have a difficult time finding transportation, especially since Solano county is large and doesn't have the easiest public transportation to work with.”
- “Like the program but concerned that my students would be unable to attend because of after school jobs/ transportation needs.”
- “Great program, but without support to get student to the locations and there are not that many teacher around here willing to act as transportation agents for students.”
- “Neat experience for kids, but too far from school to be practical.”

The teachers in the Solano County focus group thought this program sounded good and

liked how it was something that students could do outside the classroom. One teacher thought one could partner with UC Davis, UC Berkeley, or Sonoma State. In addition, it would look good on a resume for a student and provide more one-on-one time for the students.

The Marin County teachers' thoughts about the third program include:

- “I like that students would have to choose to attend. I like that students would be exposed to more science through an internship in the summer/after school.”
- “We have a class in the Tamalpais Union High School District called ""Independent Science Research"" which means that our student could get course credit for participating in a program like this.”
- “I like the idea of ways to get students involved in independent service projects and have them try out possible interests.”
- “Internship are already in place at my school, but meaningful scientific level ones are currently lacking in the Bay Area and this would be a very positive addition to the program!”
- “Having both after school and summer options might be very useful. Getting students' feet wet, so to speak, can really inspire and motivate and focus. Love it.”
- “This is exactly in line with our school philosophy and would be a great experience for some students! If it was after school, it may be a challenge for students to commit their time, but I would give them credit and excuse from assignments during that time in exchange for them presenting to the class.”
- “I would not attend, but would encourage my students to do so”
- “Can students use this as a vehicle to complete their school science fair projects?”
- “How do students transport themselves to these activities?”
- “After school would work, although many of our kids are involved in sports. summer? hard to tell.”
- “It would be rare to find a student who would have time to do this”

Overall the teachers in the Marin County focus groups also liked this program. In both of the focus groups, the teachers discussed having an internship for students before this program was presented. One teacher liked this program especially if the students are learning how to do “real science.” Also one of the schools has a science fair requirement, so the teachers thought this program would go well with that so students could have scientist support. The teachers thought this program would be fairly easy to implement because the students can work out the details, can contact the scientists, and many are already looking for internships.

Hurdles in Participating in NERR Programs

A discussion of some of the obstacles or hurdles that would affect the likelihood of teachers participating in the NERR programs have been discussed some throughout this report. The teachers also responded to some direct questions regarding these obstacles. Table 19 displays the factors that teachers felt would affect their ability to attend professional development training. The results indicate that the top five barriers in Solano County included no funding at school, difficulty getting a substitute, high registration fees, travel/transportation constraints, and getting time off. In Marin County, funding is

less of a concern and the top six barriers included not having time/being too busy, training is not relevant to needs, high registration fees, travel/transportation constraints, difficulty getting a substitute, and difficulty getting time off. Some of the teachers listed other hurdles that included family responsibilities, other priorities/interests, do not hear about opportunities that often, have a degree in Aquatic Biology so already have more experience than most peers, substitutes are not available in district for professional development (prefer weekend trainings), and child care issues. One of the focus group teachers in Marin County discussed how only training that focused on English Learners would be supported by the administration.

Table 19: FACTORS AFFECTING TEACHERS' ATTENDANCE IN PROFESSIONAL DEVELOPMENT – SOLANO AND MARIN COUNTIES

Factors Affecting Attendance in Professional Development Training	Solano County	Marin County
High registration fees	52%	30%
No funding at my school	67%	15%
Travel/transportation constraints	52%	20%
Difficult to get a substitute	67%	20%
Food/lodging constraints	19%	10%
Can't get time off	48%	20%
No time/too busy	38%	75%
Lack of administration support	19%	10%
Training is not relevant to my needs	24%	35%
No educational credits were offered	14%	0%
Other	10%	20%

The teachers responded to a free-response question about what could influence their ability to participate in various programs that the NERR might offer. Table 20 displays these results for Solano County. The biggest obstacle in this county is general funding and transportation costs. There were also several teachers who felt they could not participate in any programs that do not help their students prepare for the state exam. One teacher said that it would be better to have these programs in the summer time. During the focus group, one teacher felt that the last six weeks in the school year (after testing) is when the “fun things” can happen. Also since cost is such a factor bringing speakers to the classrooms and making it more local would make it easier for the teachers.

Table 20: FACTORS AFFECTING TEACHERS' ATTENDANCE IN PROFESSIONAL DEVELOPMENT TRAINING – SOLANO COUNTY

Factors Affecting Attendance in Various NERR Programs	Number of Teachers
Funding and cost	9
Timing/time commitment	6
Transportation costs	5
Logistics of taking a large number of students	3
Clear connection to curriculum/standards/exam	3
Location of the programs	2
Students not allowed to miss too many days because it takes them away from other classes	1
Substitute teacher costs	1

Table 21 displays the obstacles that the Marin County teachers reported in attending the various NERR programs. Teachers in this county had less obstacles and less funding issues than Solano County. The largest group of teachers were concerned about the timing of the activity. One teacher said weekends would be more difficult and the preference would be during the school day. A teacher in the focus group said that weekends would be preferable because they would not have to get a substitute. The group discussed if there were weekend events it would be helpful to make them “kid-friendly” so the kids have activities to do during the program. Another teacher discussed how the time before STAR testing is impacted so all programs would need to be after the testing in April. The teachers, in the focus group, did think finding time was a big factor, but supplies, stipends, and access to equipment may help with that issue. They felt offering credits would be less helpful.

Table 21: FACTORS AFFECTING TEACHERS' ATTENDANCE IN PROFESSIONAL DEVELOPMENT TRAINING – MARIN COUNTY

Factors Affecting Attendance in Various NERR Programs	Number of Teachers
Timing during the school year/Finding time	7
Funding and cost	3
High level and relevant/Fits into curriculum goals	3
No transportation	1
Programs that do not take lots of time	1
Location of the programs	1
Organization and logistics	1
Trip slip/liability - not allowed to wade above knee or go on small individual watercrafts [kayaks]	1
Standardized testing	1

Recommendations and Conclusions

In this report, we reviewed what teachers are currently teaching, professional development training, familiarity with NERR and its programs, ideas for possible programs and support, thoughts about potential programs, and hurdles in participating in various programs. The data that has been presented helps in understanding more about these two counties and what kinds of programs and professional development need to be developed and implemented. Here are some recommendations based on the data that has been presented:

1. The two counties (Solano and Marin) had very different experiences, needs, and obstacles.
 - a. Solano County is larger and finances are a much bigger concern for this group of teachers. These teachers have less freedom (because of testing and standards) trying new things in the classroom. For this County, the teachers would more likely utilize programs such as having speakers come to the schools, students having access to more data and datasets in the classroom, and sharing data among different groups or schools. It was more difficult for many of these students to do outdoor activities at school,

so we recommend for many of these schools to bring laboratory activities to the classroom to make the science more hands-on. However, any new activities would have to relate directly to existing district curriculum.

- b. Marin County had less concerns financially, but had more concerns about time. Some of the teachers discussed testing, but there was not the same pressure and teaching restrictions as in Solano County. These teachers had more flexibility in being able to bring new materials to the classroom and participating in professional development. New materials and professional development programs in estuary-related topics would be useful for this county and teachers had interest in participating. One of the districts has a San Francisco Bay course that the teachers feel needs some updating and current material; this could be a good avenue for the NERR to pursue. Also most of the schools in this county are near some type of natural waterway so they have flexibility to do some outdoor work related to water at the school site. The access to the natural waterways has much potential for a possible NERR Water Quality program.
2. Many teachers were not familiar with NERR and its resources. The teachers at the focus groups and many of those who took the survey seemed interested in learning more about the organization and its resources. If the goal is to have more teachers and classrooms using the resources and programs, then NERR needs to figure out new ways to advertise and let others know what they are doing (i.e. open houses, talking to schools, internships, etc.)
3. Many of the teachers felt that it was important that any programs, professional development, materials, etc. that are developed need to fit in with the curriculum or with the standards that are already being taught. Any educational materials that are developed should show teachers how these materials could fit into the curriculum in specific science subject areas.
4. Many teachers discussed or named LiMPETS [NOAA National Marine Sanctuary program - Long-term Monitoring Program and Experiential Training for Students] in both the surveys and the focus groups as a positive experience. This ocean program could be used as a model in designing a new watershed or estuary-related program for both counties.
5. It would be useful to examine these two groups of teachers several years from now to find out how a change in political and economic climate affects both of these counties. In addition, to find out if by developing more materials, support, and professional development the NERR and its programs have become more known by teachers and schools.

*Appendix A: Focus Group Protocol and Survey
from Phase 1*

San Francisco Bay National Estuarine Research Reserve (NERR): Teacher Focus group protocol

July 18, 2011

Goal: The goal of the focus group is to understand what high school science teachers need in regards to programs, support, and professional development related to the San Francisco Bay, including its' watershed, creeks, and wetlands. NERR would like to better understand how to support science teachers in Solano County and Marin County to teach students about the estuaries and watersheds through participation in fieldwork, data collection, and analysis. The information will be used to revise and create educational programs that meet the needs of teachers.

Introduction – Sarah

[10 minutes]

Reserve 10 minutes for introduction

[For the facilitator:

1. *Begin with a brief description of the purpose of the focus group and how the information gathered will be used*
2. *Explain that we want to hear from everyone, and that we really want to make sure that we have a discussion about the different topics.]*

1. First, let's go around the table, and tell me your name, what grade levels and science discipline you teach, and how many years you have been teaching.

Current Teaching – Rebecca

[25 minutes]

[Facilitator: I'd like to talk you a bit about your experiences with teaching about estuaries and watersheds (Define estuary aloud or put definition on easel paper: An estuary is a semi-enclosed coastal body of water where fresh and salt water meet and mix). Also your experience in the classroom with fieldwork (or field research), data collection, looking at and analysis of data]

1. What topics have you taught related to estuaries and watersheds?
 - a. *Probe for context/module, how much it is part of the normal curriculum vs. how much is driven by the interest of that specific teacher*
 - b. Can you talk about some of the details about how you taught these units?

- c. How much time you spent on the unit?
 - d. What did you do with the students?
 - e. Were there any outdoor or field experiences related to this unit? What kind?
2. Please describe your experiences working with students in the following areas:
 - a. Fieldwork or field research
 - b. Data collection
 - c. Looking at and analyzing data
 3. What are some barriers in being able to teach more estuary and watershed-related content with the current curriculum?
 4. If you could teach more estuary/watershed-related content in the curriculum, what topics would you like to include?
 - a. What are your thoughts about the topic of water quality? Is this a topic that you would like to address in your classroom?
 - i. If yes, what would you like to address in regards to the topic of water quality?
 5. What help do you think you need in order to address this content?
 - a. Probe for:
 - i. Content help
 - ii. Materials
 - iii. Lesson plans
 - iv. Ways to interest students
 6. Do you feel that your school/principal/district would be open to the idea of adding estuary/watershed-related content? Why or why not?

Professional Development – Rebecca

[25 minutes]

[Facilitator: I'd like to talk you a bit about professional development experiences you have had related to the topic of estuaries (wetlands, creeks, watersheds).]

1. What topic(s) have you covered in your professional development related to estuaries or watersheds?
 - a. Where did you take the professional development training?
 - b. Did you take what you learned and utilize it in the classroom?
 - i. If yes, what kind of ongoing support did you have that allowed you continue it in the classroom?
 - ii. If no, what kind of ongoing support would have allowed you to continue it in the classroom?
 - c. In general, what other kind of ongoing support or help do you feel you would need to be able to take what you learn in professional development and continue using it in the classroom?
2. Would you like more professional development on the topic of estuaries/watersheds/wetlands/creeks)?
3. What topics specifically would you be interested in having more professional development on?

4. What kind of professional development have you received in the following areas:
 - a. Fieldwork or field research
 - b. Data collection
 - c. Looking at and analyzing data
5. Would you be interested in more professional development on the topic of estuaries/watersheds that involve
 - a. Fieldwork or field research
 - i. If yes, what kind?
 - b. Data collection
 - i. If yes, what kind?
 - c. Looking at and analyzing data
 - i. If yes, what kind?

NERR Programs and Participation – Rebecca

[35 minutes]

1. What are other kinds of programs or support that can be provided to help you teach students more about the San Francisco Bay and its estuaries/watersheds? (These can be programs at a reserve, on your school site, etc. These can be anything i.e. trainings, supporting students collecting data, field trips, educational materials, etc.)
 - a. Please discuss the program or support.
2. *Hand out Sarah's list of possible programs to the participants. Give teachers a few minutes to look over the list (See pages B-4 through B-6 for the list and description of the programs). What are your thoughts about each of these programs? Which of these programs would you be interested in participating in? Please explain why you are or why you are not interested in each program.*
3. What is the likelihood you would participate in programs, trainings, field trips, etc. offered by NERR if they were of interest to you or were related to the curriculum you taught?
4. What are some barriers that could influence your ability [or your school's ability?] to participate in the NERR programs?
 - a. *Probe for systemic level – e.g., no funds or time for PD; no time to add anything to the curriculum*
 - b. *Probe for personal level – more interest in other areas, need to be able to earn credits, etc.*
5. Do you have some thoughts about how those barriers could be reduced?

Thank you for your time!

We are interested in learning a bit about your background and experience with estuaries before you come to the focus group. Please respond to the questions below using these definitions for the science related term. We greatly appreciate your participation.

Estuary: An estuary is a semi-enclosed coastal body of water where fresh and salt water meet and mix.

Watershed: An area of land where all the water drains to a common place.

Ocean: Related to a system of open-ocean habitats, characterized by exposure to wave action, tidal fluctuations and ocean currents.

1. How many years have you been teaching estuary, watershed and ocean related topics?

	None	Less than 2 years	2-3 years	4-5 years	6-7 years	8-9 years	10-15 years	More than 15 years
Estuaries	<input type="radio"/>							
Watershed	<input type="radio"/>							
Ocean	<input type="radio"/>							

2. How many class or activity periods of estuary, watershed, and/or ocean instruction do your students receive in a typical school year?

	None	A portion of one class	One to two classes per year	3 to 5 classes per year	6-15 classes per year	More than 15 classes per year
Estuaries	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
Watershed	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
Ocean	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>

3. In the last three years, how many hours of professional development training in science have you obtained related to estuaries, watersheds and the ocean?

	None	Less than 8 hrs	8 hrs (1 day)	9-16 hrs (2 days)	17-24 hrs (3 days)	25-32 hrs (4 days)	33-40 hrs (5 days)	More than 40 hours
Estuaries	<input type="radio"/>							
Watershed	<input type="radio"/>							
Ocean	<input type="radio"/>							

4. Which professional development trainings have you taken to supplement your estuary/watershed/ocean education? Check all that apply.

- NOAA/NERRS Teachers on the Estuary Training
- Project WET
- Project Wild Aquatic
- Green Eggs and Sand Workshop
- The Jason Project Professional Development
- None of the above
- Other (please specify)

5. Are CEUs (continuing education units) important or required in determining which professional development opportunities you participate?

Yes

No

6. Are PLUs (professional learning units) important or required in determining which professional development opportunities you participate?

Yes

No

7. What factors prevent you from attending professional teacher development? Please check the three that most commonly occur.

High registration fees

Travel/ transportation constraints

Food/lodging constraints

Can't get time off

No time/too busy

Lack of administration support

Training is not relevant to my needs

No educational credits were offered

Other (please specify)

8. What type of professional development training do you need? Check all that apply.

Science content

Facilitating inquiry-based activities

Conducting hands-on activities

Incorporating new lab activities

Facilitating field work/data collection

Analyzing data

Using computer-generated visualizations of data

Using new websites

Using real-time or archived data from monitoring sites

Other (please specify)

9. Which real-time/archived science data streams have you used in your teaching? Check all that apply.

***Note: We're defining real-time data streams as data that you can access as the data are being collected by scientific instruments, or shortly thereafter, to study current conditions or events. Archived data are defined as older data that are still important and necessary for future reference, but are stored and indexed so that they can be easily located and retrieved.**

- algal blooms
- animal tag/tracking
- atmospheric carbon dioxide
- bathymetry/topography
- currents
- dissolved oxygen (DO)
- fish species & abundance
- nutrients
- ocean color
- pH
- salinity
- sea level rise
- temperature: air
- temperature: water
- water depth
- water contaminants
- water turbidity (clarity/cloudiness)
- waves
- zooplankton species
- None of the above
- Other (please specify)

10. Think about your plans for your class for the entire year. How much emphasis did you or will you give each of the following?

	Little or no emphasis	Moderate emphasis	Heavy emphasis	N/A
Outdoor experiential activities	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
Lab or Field Work/data collection	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
Stewardship projects or activities	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
Data analysis, statistics, and probability	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
Scientific inquiry skills	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>

11. What kind of outdoor experiential opportunities/activities are your students provided with?

12. What help do you need to incorporate more outdoor education in your classroom? Check all that apply.

- Unstructured outdoor experiential activities
- Backpacks with field guides, binoculars, magnifying glasses and activity guides, among others.
- Facilitating inquiry-based activities
- Conducting hands-on activities
- Guidance on monitoring activities
- Facilitating field work/data collection
- Other

13. Are estuary and estuary-related topics a required part of your school's science teaching requirements?

- Yes No

14. Are estuary and estuary-related topics a required part of your district's science teaching requirements?

- Yes No

15. Which topics would you like to see developed into educational materials? Check all that apply.

- Ecology
- Use of Data in the Classroom
- Climate Change and Sea Level Rise
- Human Impacts and Stewardship Actions
- Scientific Research
- Cultural Heritage
- Rivers and Watersheds
- Water-Quality (i.e. physical properties of water, water density, salinity)
- Wetlands/Marshes
- Other (please specify)

16. What help do you need to incorporate more discussion about the effects of climate change on coastal areas in your classroom?

17. Do you foresee a need for new estuary/ocean/watershed related educational materials in different languages?

- Yes No

If yes, which language(s)?

18. From which web resources do you currently obtain estuary, watersheds, and ocean information for use in your classroom? Check all that apply.

- NOAA's Education Website - <http://www.education.noaa.gov>
- National Estuarine Research Reserve System's Website - <http://nerrs.noaa.gov>
- National Estuarine Research Reserve System's, Education Website – <http://www.estuaries.gov>
- San Francisco Bay National Estuarine Research Reserve's Website - www.sfbaynerr.org
- California State government Website - <http://www.ca.gov/>
- NSTA Estuaries Sci Guide - <http://sciguides.nsta.org>
- EPA Education Website - <http://www.epa.gov/enviroed/>
- Wikipedia - <http://wikipedia.org>
- National non-profit.
- Local non-profit
- I do not use web resources.
- Other

19. If you checked National non-profit as a web resource, which one(s)?

20. If you checked Local non-profit as a web resource, which one(s)?

21. Which of the following real-time/archived data sets would you need synthesized into age-appropriate learning materials and visualizations for your teaching? Check all that apply.

***Note: We're defining real-time data streams as data that you can access as the data are being collected by scientific instruments, or shortly thereafter, to study current conditions or events. Archived data are defined as older data that are still important and necessary for future reference, but are stored and indexed so that they can be easily located and retrieved.**

- algal blooms
- animal tag/tracking
- atmospheric carbon dioxide
- bathymetry/topography
- currents
- dissolved oxygen (DO)
- fish species & abundance
- nutrients
- ocean color
- pH
- salinity
- sea level rise
- temperature: air
- temperature: water
- water depth
- water contaminants
- water turbidity (clarity/cloudiness)
- waves
- zooplankton species
- None of the above
- Other, please specify

22. What is your name?

23. Are you a teacher in Solano County or Marin County?

Solano County

Marin County

24. There is a National Estuarine Research Reserve called San Francisco Bay NERR located in San Rafael (China Camp State Park) and Suisun City (Rush Ranch Open Space Preserve), which together make up one of 28 Reserves around the country protected for the purposes of education, research, water-quality monitoring and coastal stewardship. Were you aware that your state has a National Estuarine Research Reserve?

Yes

No

25. If “yes”, have you ever used any of their educational services or products?

Yes

No

26. If yes, which services or products?

27. If no, why not?

Appendix B: Survey from Phase 2

We are interested in learning a bit about your background, experience, interests, and needs in the topic of estuaries, creeks, and watersheds. The goal is to develop programs, support, and professional development for teachers. NOAA San Francisco Bay National Estuarine Research Reserve (NERR) sponsors this program. NERR is creating new educational programs for teachers in Marin and Solano counties and would like your input and feedback on what kinds of programs and professional development opportunities should be developed.

Please respond to the questions below using these definitions for the science related term. We greatly appreciate your participation.

Estuary: An estuary is a semi-enclosed coastal body of water where fresh and salt water meet and mix.

Watershed: An area of land where all the water drains to a common place.

Ocean: Related to a system of open-ocean habitats, characterized by exposure to wave action, tidal fluctuations and ocean currents.

1. How many years have you been teaching estuary, watershed and ocean related topics?

	None	Less than 2 years	2-3 years	4-5 years	6-7 years	8-9 years	10-15 years	More than 15 years
Estuaries	<input type="radio"/>							
Watershed	<input type="radio"/>							
Ocean	<input type="radio"/>							

2. How many class or activity periods of estuary, watershed, and/or ocean instruction do your students receive in a typical school year?

	None	A portion of one class	One to two classes per year	3 to 5 classes per year	6-15 classes per year	More than 15 classes per year
Estuaries	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
Watershed	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
Ocean	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>

3. Are estuary and estuary-related topics a required part of your school's science teaching requirements?

Yes No

4. Are estuary and estuary-related topics a required part of your district's science teaching requirements?

Yes No

5. What topics have you taught related to estuaries and watersheds? Are these topics discussed within the context of the San Francisco Bay, including Suisun Bay, or are they discussed at a more general level?

6. In the last three years, how many hours of professional development training in science have you obtained related to estuaries, watersheds and the ocean?

	None	Less than 8 hrs	8 hrs (1 day)	9-16 hrs (2 days)	17-24 hrs (3 days)	25-32 hrs (4 days)	33-40 hrs (5 days)	More than 40 hours
Estuaries	<input type="radio"/>							
Watershed	<input type="radio"/>							
Ocean	<input type="radio"/>							

7. Which professional development trainings have you taken to supplement your estuary/watershed/ocean education? Check all that apply.

- NOAA/NERRS Teachers on the Estuary Training
- Project WET
- Project Wild Aquatic
- Green Eggs and Sand Workshop
- The Jason Project Professional Development
- Long-term Monitoring Program and Experiential Training for Students (LiMPETS)
- None of the above
- Other (please specify)

8. Are CEUs (continuing education units) important or required in determining which professional development opportunities you participate?

- Yes No

9. Are PLUs (professional learning units) important or required in determining which professional development opportunities you participate?

- Yes No

10. What factors prevent you from attending professional teacher development? Please check all those that apply.

- High registration fees
- No funding at my school
- Travel/ transportation constraints
- Difficult to get a substitute
- Food/lodging constraints
- Can't get time off
- No time/too busy
- Lack of administration support
- Training is not relevant to my needs
- No educational credits were offered
- Other (please specify)

11. What type of professional development training do you need? Check all that apply.

- Science content
- Facilitating inquiry-based activities
- Conducting hands-on activities
- Incorporating new lab activities
- Facilitating field work/data collection
- Analyzing data
- Using computer-generated visualizations of data
- Using new websites
- Using real-time or archived data from monitoring sites
- Other (please specify)

12. Please describe professional development programs that you would find helpful and would likely attend if they are offered that are related to estuaries, watersheds, field research, data collection, or looking at and analyzing data.

13. What other kinds of programs or support would help you teach students more about the San Francisco Bay and its tributaries or watershed?

(These can be programs at a reserve, on your school site, etc. These can also be anything i.e. trainings, supporting students collecting data, field trips, educational materials, etc.)



14. Please read the following possible NERR program:

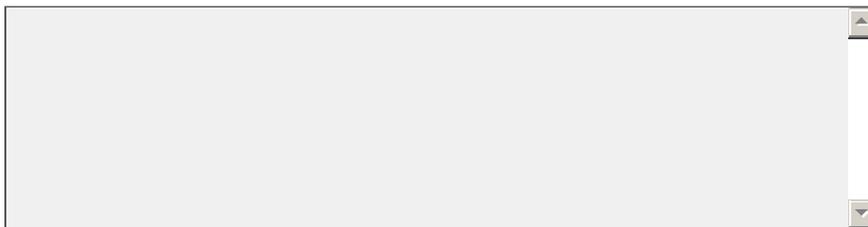
Program 1: Water Quality Monitoring throughout the Watershed:

Description: Classes would conduct water-quality monitoring in the tributaries to the San Francisco Bay, especially the watersheds of Gallinas Creek and Corte Madera Creek in Marin County and Suisun Marsh in Solano during class time. The teachers and students would also have access to water-quality monitoring data collected by the Reserve's automated water quality stations in the San Francisco Bay, and possibly by other schools within the watershed, to allow for more meaningful research questions and discussions. The Reserve would also provide lesson plans, use of water-quality monitoring equipment, and possibly professional development and sharing opportunities to participating teachers.

Would you be likely to attend this program?

- Yes
- No
- Maybe

What are your thoughts or suggestions about this program? What aspects of this program do you like? What aspects of this program would you change?



15. Please read the following possible NERR program:

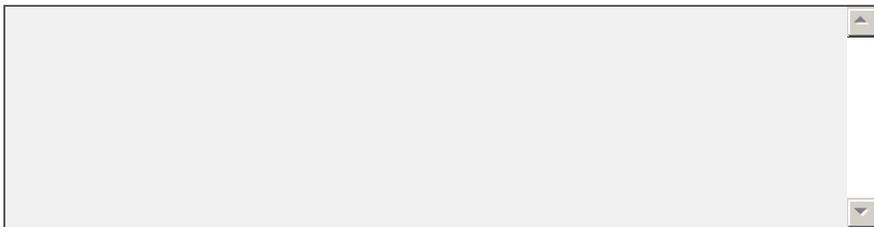
Program 2: Bay Science Series for Teachers

Description: A series of classes about specific estuarine science topics, such as water quality monitoring, climate change impacts on the marsh, basic ecology of tidal marshes, etc. Classes would offer a balance of field-research experiences, lectures by Reserve educators and occasionally by expert scientists, and professional sharing opportunities to learn from other science teachers. Teachers who attend the whole series and complete an in-class project would receive credits from San Francisco State University's College of Extended Learning or a stipend for research supplies for the classroom.

Would you be likely to attend this program?

- Yes
- No
- Maybe

What are your thoughts or suggestions about this program? What aspects of this program do you like? What aspects of this program would you change?



16. Please read the following possible NERR program:

Program 3: Estuary Science Internship for Students

Description: Students would be selected to participate in an internship program coordinated by Reserve educators. Students would each complete an independent monitoring, research or stewardship project. They would also attend a short series of classes about estuaries, attend a career panel with scientists from different disciplines sharing their career paths and daily work, and participate in field research activities. The internship program could occur after-school or during the summer.

Would you be likely to attend this program?

- Yes
- No
- Maybe

What are your thoughts or suggestions about this program? What aspects of this program do you like? What aspects of this program would you change?

17. What factors could influence your ability (or your school's ability) to participate in these various programs about the San Francisco Bay, including Suisun Bay, and its tributaries and watershed?

18. Think about your plans for your class for the entire year. How much emphasis did you or will you give each of the following?

	Little or no emphasis	Moderate emphasis	Heavy emphasis	N/A
Outdoor experiential activities	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
Lab or Field Work/data collection	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
Stewardship projects or activities	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
Data analysis, statistics, and probability	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
Scientific inquiry skills	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>

19. What kind of outdoor experiential opportunities/activities are your students provided with?

20. What help do you need to incorporate more outdoor education in your classroom? Check all that apply.

- Unstructured outdoor experiential activities
- Backpacks with field guides, binoculars, magnifying glasses and activity guides, among others.
- Facilitating inquiry-based activities
- Conducting hands-on activities
- Guidance on monitoring activities
- Facilitating field work/data collection
- Other

21. Which topics would you like to see developed into educational materials? Check all that apply.

- Ecology
- Use of Data in the Classroom
- Climate Change and Sea Level Rise
- Human Impacts and Stewardship Actions
- Scientific Research
- Cultural Heritage
- Rivers and Watersheds
- Water-Quality (i.e. physical properties of water, water density, salinity)
- Wetlands/Marshes
- Other (please specify)

22. What help do you need to incorporate more discussion about the effects of climate change on coastal areas in your classroom?

23. Do you foresee a need for new estuary/ocean/watershed related educational materials in different languages?

Yes

No

If yes, which language(s)?

24. From which web resources do you currently obtain estuary, watersheds, and ocean information for use in your classroom? Check all that apply.

- National Oceanic and Atmospheric Administration's Education Website - <http://www.education.noaa.gov>
- National Estuarine Research Reserve System's Website - <http://nerrs.noaa.gov>
- National Estuarine Research Reserve System's, Education Website – <http://www.estuaries.gov>
- San Francisco Bay National Estuarine Research Reserve's Website - www.sfbaynerr.org
- California State government Website - <http://www.ca.gov/>
- National Science Teachers Association's Estuaries Sci Guide - <http://sciguides.nsta.org>
- Environmental Protection Agency's Education Website - <http://www.epa.gov/enviroed/>
- Wikipedia - <http://wikipedia.org>
- National non-profit.
- Local non-profit
- I do not use web resources.
- Other

25. If you checked National non-profit as a web resource in question #24, which one(s)?

26. If you checked Local non-profit as a web resource in question #24, which one(s)?

27. Which real-time/archived science data streams have you used in your teaching? Check all that apply.

***Note: We're defining real-time data streams as data that you can access as the data are being collected by scientific instruments, or shortly thereafter, to study current conditions or events. Archived data are defined as older data that are still important and necessary for future reference, but are stored and indexed so that they can be easily located and retrieved.**

- algal blooms
- animal tag/tracking
- atmospheric carbon dioxide
- bathymetry/topography
- currents
- dissolved oxygen (DO)
- fish species & abundance
- nutrients
- ocean color
- pH
- salinity
- sea level rise
- temperature: air
- temperature: water
- water depth
- water contaminants
- water turbidity (clarity/cloudiness)
- waves
- zooplankton species
- None of the above
- Other (please specify)

28. Which of the following real-time/archived data sets would you need synthesized into age-appropriate learning materials and visualizations for your teaching? Check all that apply.

***Note: We're defining real-time data streams as data that you can access as the data are being collected by scientific instruments, or shortly thereafter, to study current conditions or events. Archived data are defined as older data that are still important and necessary for future reference, but are stored and indexed so that they can be easily located and retrieved.**

- algal blooms
- animal tag/tracking
- atmospheric carbon dioxide
- bathymetry/topography
- currents
- dissolved oxygen (DO)
- fish species & abundance
- nutrients
- ocean color
- pH
- salinity
- sea level rise
- temperature: air
- temperature: water
- water depth
- water contaminants
- water turbidity (clarity/cloudiness)
- waves
- zooplankton species
- None of the above
- Other, please specify

29. There is a National Estuarine Research Reserve called San Francisco Bay NERR located in San Rafael (China Camp State Park) and Suisun City (Rush Ranch Open Space Preserve), which together make up one of 28 Reserves around the country protected for the purposes of education, research, water-quality monitoring and coastal stewardship. Were you aware that your state has a National Estuarine Research Reserve?

Yes

No

30. If “yes” to question #29, have you ever used any of their educational services or products?

Yes

No

If yes, which services or products? If "no", why not?

31. Are you a teacher in Solano County or Marin County?

Solano County

Marin County

32. What is the name of the school where you teach?

33. What is your name and email address?

(Your name and email address will not be connected with the rest of the survey or the data. The purpose of this question is to be able to email your \$20 gift card)

Name:

Email Address:

Appendix C: Additional Required Data Material

TABLE 1C: SOLANO COUNTY HIGH SCHOOLS REQUIREMENTS FOR ESTUARY-RELATED TOPICS

Schools	Required at School and District
Fairfield	Not Clear
Angelo Rodriguez	No
Armijo	Not Clear
Vacaville	No
Vanden	Not Clear
Will C. Wood	No
Mare Island Technology Academy (Charter School)	Not Clear
Benicia	No
Dixon	No
Country	Did not Participate
Jesse M. Bethel	Did not Participate
Vallejo	Did not Participate

TABLE 2C: MARIN COUNTY HIGH SCHOOLS REQUIREMENTS FOR ESTUARY-RELATED TOPICS

Schools	Required at School and District
Marin Catholic (Private School)	Not Clear
Redwood	Yes
Sir Francis Drake	Not Clear
San Domenico (Private School)	Not Clear
San Rafael	No
Tamalpais	No
Marin Academy (Private School)	No
Novato	No
San Marin	No
Tamiscal	Yes
Terra Linda	No
San Andreas	Did not Participate

Table 3C: TOPICS INTERESTED IN DEVELOPING INTO EDUCATIONAL MATERIALS – SOLANO AND MARIN COUNTIES

Topics	Solano County (N = 22)	Solano County - Percent	Marin County (N = 21)	Marin County - Percent
Ecology	15	68%	11	52%
Use of data in the classroom	12	55%	8	38%
Climate change and sea level rise	11	50%	12	57%
Human impacts and stewardship actions	12	55%	10	48%
Scientific research	15	68%	7	33%
Cultural heritage	5	23%	5	24%
Rivers and watersheds	10	46%	8	38%
Water-quality (i.e. physical properties of water, water density, salinity)	15	68%	16	76%
Wetlands/marshes	8	36%	13	62%
Other	3	14%	0	0%

Table 4C: GENERAL PROFESSIONAL DEVELOPMENT TRAINING NEEDS – SOLANO AND MARIN COUNTIES

Topics	Solano County (N = 22)	Solano County - Percent	Marin County (N = 21)	Marin County - Percent
Science content	8	36%	3	14%
Facilitating inquiry-based activities	13	59%	7	33%
Conducting hands-on activities	12	55%	10	48%
Incorporating new lab activities	18	82%	16	76%
Facilitating field work/data collection	9	41%	8	38%
Analyzing data	7	32%	1	5%
Using computer-generated visualizations of data	7	32%	4	19%
Using new websites	5	23%	5	24%
Using real-time or archived data from monitoring sites	5	23%	7	33%
Other	4	18%	2	10%