

Progress Report for High Tech High, Integrated Study of San Diego Bay

Phase I

The integrated study of San Diego Bay at High Tech High took place in three different disciplines: Math, Biology and Humanities. In the beginning of the year we reviewed with students past student work on San Diego Bay. This included publications and student documentaries. Another foundation component was providing some opportunities for students to discover different community issues and contacts by attending events that are going on around the Bay.

We brought students to two separate community presentations in the Fall. The first was a San Diego Travel Expo which arranged an Environmental Section for local environmental groups to present in. We were invited by the San Diego Oceans Foundation to share their booth. Students had an opportunity to interact with a broad range of people in San Diego and share past work and plans for future studies of San Diego Bay. The second community event was the Cabrillo Festival which was an excellent opportunity for students to discover the rich multicultural history in San Diego. This event is highlighted by a reenactment of Juan Cabrillo's landing in San Diego Bay in 1542. We were part of the agenda and had a booth along the shore of the Bay at the historic Ballast Point. Students sold books from past projects and also discussed their current water quality study. This was an excellent opportunity for students to be exposed to the different cultures (Kumeyaay, Spanish, Portuguese, and Mexican) of the Bay that shaped the community during the formation of the city of San Diego. The day was filled with cultural music, dance, costumes, games, and story telling of these different nations.

Another community learning project has been centered around field outings conducted by the students. These are coordinated by the students after getting approval by project teachers. Some include wetland restoration projects or attending local lectures or conferences related to water quality or environmental stewardship. Following the field outing students write up project summaries and reflections. Students have also been taking photos of the events, some of which have been posted on the different environmental steward websites.

In biology much of the focus of the study was on developing methods for the identification of invasive species using DNA barcoding technology. The methodology was initially established by Jay Vavra with collaboration between the Center for Research of Endangered Species of the San Diego Zoological Society and a partnership with the Smithsonian. Student investigations were initiated by a review of published studies along with research and presentations on the key molecular approaches involved in DNA barcoding. Students have taken a series of field trips to collect and observe the marine invertebrates growing in the Bay near our school and also on a protected dock at Grape St. Pier that was provided for us by the Port of San Diego. At the dock we have

suspended ropes that provide substrate for newly arriving creatures to attach and settle on. Students retrieve the ropes periodically to determine the succession of species and the changing fauna of the Bay. The results for the species identification component have also been very interesting. We have discovered a single methodology for amplifying DNA from a very diverse set of creatures that includes the phyla: Chordata, Echinodermata, Platyhelminthes, Porifera, Mollusca, Arthropoda and Ectoprocta. This allows us to analyze the biodiversity of the fauna of the bay and will help identify invasive species rapidly before they proliferate in the region.

In biology students also conducted studies in environmental microbiology and developed methods to sample and culture local microbes. The next step will be to screen local water for enteric bacteria and also determine viability of *E. coli* and other potentially pathogenic bacteria in sea water.

In Math they conducted an assessment of pollution in our watershed with GIS technology. During the planning phase of the project over the summer, Julia Gordon attended a one-week workshop focused on the use of GIS for conservation issues. At the start of the year, to get the project rolling with the students, Dr. Ming Tsou, professor of geography at San Diego State University along with one of his graduate students gave a series of presentations to our students about the uses of GIS in our society and specific applications to our study. Dr. Tsou has established watershed maps for the Port of San Diego in the past.

In Humanities, students began the investigation of both the historical contributions to our environmental crises, as well as, the environmental factors and political positions which effect current decision making. There was an investigation of the past, in order to better understand the perspectives Western culture has taken toward the environment. The debate regarding our adversarial belief of dominion over the environment is engaged with the concept of stewardship and conservation.

The whole team visited the Chula Vista Nature Center which is a reserve that is involved in protecting salt marsh habitat in the South Bay and educating the local community about the wildlife of the region. The focus for our group was three-fold: first, understanding the role of the wetland environment related to water quality issues in the Bay; second, assessment of the species abundance and diversity of native plants in the coastal scrub along the salt marsh; and third, illuminated journal writing by students related to the concept of what is natural vs. unnatural in the region.

Phase II

Initially, student groups struggled and failed to accurately depict an overview of the cause and effect relationships involved in water quality issues of San Diego Bay. They attempted to map out the source of pollutants and the interconnected issues across the Bay. This was done using a variety of computer programs. Although some results were promising, none of them accurately portrayed the issues and connections. Organization was also lacking in their displays.

Finally, one student group suggested an alternative approach. This group recommended having students place all of the components on the floor, organize them with the class and then link them with thread. This ended up being a brilliant plan. The activity involved all of the students and they had to communicate and share their knowledge to accomplish the task. It also gave every student a chance to contribute. The activity was photographed from above and turned into a great time-lapse study of student interaction across different classes. The photos also turned out to be a nice grading tool for class participation!



The species identification work using DNA barcoding has been very successful and will be expanded to understand more of the community in each watershed. Bioindicator work has been developed but the methods

used have not had the sensitivity to show differences in water sources. This is potentially a good sign that water quality in regions tested has not been as bad as expected but needs to be tested further to make such a conclusion.

In math students completed a systematic survey of watershed regions using GIS. Surveys were conducted on planned routes looking at litter along city streets. The regions were defined by the inner edge of a sidewalk to the outer edge of the street gutter. The litter was tagged with GPS units and marked as glass, plastics, paper, animal feces, metal, and cigarette butts. Each piece of trash was collected, and coordinates were marked in the GPS device. The coordinates in the GPS device were uploaded into Google Earth Pro and GIS (Geographical Information System). Using these two programs, the students created two San Diego Pollution Maps.

In humanities, their was a goal to foster a greater appreciation for our fragile environment and its restoration. The approach was to conduct a study of the environment as the consequence of historical revolutions. Working through an understanding of the agricultural revolution, the rise of the industrial revolution in America, we now face an era of globalization and a world community with finite resources and a closed system. We have sought to understand how these events have impacted our relationship with our environment and what proposals or suggestion might come from them.

Additionally, students have conducted truly multidisciplinary projects by producing *in situ* river art. These projects have been inspired by Andy Goldsworthy's "Rivers and Tides" and have led to some beautiful creations. The projects utilize materials found near rivers, creeks, or the Bay. Similar to the ephemeral nature of the bodies of water they are associated with, the art projects are temporary in nature. After completion, each project is photographed to turn it into a permanent object of river art.



Phase III

We will definitely continue this study into the future. The water quality issues in the region only worsen and a need to describe the problems and find solutions becomes more imperative everyday.

We are currently organizing a union of Roots & Shoots groups and World Water Monitoring Day organizations at the Wild Animal Park of the Zoological Society of San Diego for this coming Fall. Additionally, the upcoming annual meeting of the Pacific Division of AAAS will have a session on our San Diego Bay Studies during the "Sustainability" themed meeting.

There were 68 students within our teaching team that took part in the project. Environmental education is getting more challenging every year as the student population becomes more disconnected with nature. We feel proud in continuing these endeavors in fighting the "Nature Deficit Syndrome" but it makes it harder each and every year.