

Instructionally Related Activities Report Form

SPONSOR: Geoffrey Dilly

PROGRAM: BIOLOGY

ACTIVITY TITLE: Trip to the Long Beach Aquarium – NOAA In-service Day

DATE (S) OF ACTIVITY: NOV. 14, 2015

Thank you for your commitment to engaging our students!!

A. ADDRESS THE FOLLOWING QUESTIONS:

(1) PROVIDE A DESCRIPTION OF THE ACTIVITY

This activity was a Saturday field trip to the Aquarium of the Pacific in Long Beach for the students in the Biology 499: Sea Change capstone course. The experience included a guided tour behind the scenes gauged at college level students at the Aquarium, set up in advance between myself and aquarium educational staff. In addition, many marine groups had tables staffed by researchers and scientists that gave the students a wide range of potential job opportunities in the marine sciences. In addition, students had several hours to explore the aquarium on their own, and they were required to write a 1-2 page reflection essay on their thoughts about the trip.

(2) HOW DID THE ACTIVITY RELATE TO A COURSE(S) AND/OR LEARNING OBJECTIVES?

The students who participated in the trip were all members of my Biol 499 capstone course – Sea Change. This course centers on on Ocean Conservation and Marine Biology. It featuring weekly student presentations, journal discussions, and proposal writing. The aquarium trip reinforced many of the themes they encountered during the semester. This activity allowed the students to connect with the animals and plants they've learned about in class, as well as make connections concerning many aspects of ocean conservation with real life examples including potential job opportunities.

(3) WHAT DO YOU SEE AS THE STRENGTHS OF THE ACTIVITY?

The biggest strengths of this activity revolved around creating a tangible space for students to understand the course material about ocean conservation and marine biology, as well as meet people at universities, government sectors, and private industries that



work in marine biological processes. Several students told me that they had made contacts with groups that were presenting at the Aquarium and would follow up for job and volunteer opportunities after they graduate.

(4) WHAT WOULD YOU SAY ARE/WERE THE ACTIVITY'S WEAKNESSES?

The only weakness I perceive about this is the logistics of getting 24 students together on a Saturday for a bus trip, but it worked perfectly this time.

(5) HOW WOULD YOU IMPROVE THIS ACTIVITY FOR NEXT TIME?

To improve the next iteration of this event, I'll introduce the groups that will be presenting at the Aquarium ahead of time so the students will know who will be present and be able to seek them out more actively.

(6) WHAT DID YOU LEARN FROM THE PROCESS?

As a new faculty, I learned that CI students respond well to opportunities to learn about science in the field, and that their excitement was able to translate back to renewed participation and engagement in the classroom.

(7) WHAT ARE STUDENT RESPONSES TO THE ACTIVITY? ATTACH STUDENT EVALUATIONS OR ASSESSMENTS (IN ACCORDANCE WITH FERPA RESTRICTIONS YOU MUST REMOVE ALL PERSONALLY IDENTIFIABLE STUDENT INFORMATION)

An anonymous selection of student reflection essays are included in the supplemental forms.

8) GIVE A SUMMARY OF EXPENSES FOR THE ACTIVITY.

The expenses for this activity were in two categories – transportation to get to the aquarium, and tickets for the students to attend a behind the scenes tour and enter the aquarium.

B. ATTENDEE LIST- SEPARATE SUPPORTING DOCUMENT:

In addition to the report form, *in a separate document*, attach to your email a list of attendees complete with each student major and grade level. This for IRA Committee reference only and will not be published on the IRA website. Include your name and the title of your IRA activity on the document.

C.IMAGES FROM ACTIVITY:

Finally, include up to 6 images demonstrating student participation (under 2.5 MB total). You MUST include captions/titles for each photo. You may put these photos in a Word or PDF format, or attach these photos in JPEG format directly to email. Thank you!



Students looking at food production tanks during the behind-the-scenes tour.



Students listen on as a tour guide for the behind-the-scenes tour describes the filtration systems employed to keep the aquaria clean and functioning.



Students take photos of sea horses held in a quarantine tank during the behind-the-scenes tour of the Long Beach Aquarium of the Pacific.



List of Students for IRA 679- Aquarium Trip

Arevalo,Victoria Helene	Undergraduate - BS: Biology	Senior
Assar,Sarah Elizabeth	Undergraduate - BS: Biology	Junior
Clay,Collin Alexander	Undergraduate - BS: Biology	Senior
Garcia,Dana Trisha Duque	Undergraduate - BS: Biology	Senior
Garcia,Evelyn Yvette	Undergraduate - BS: Biology	Senior
Lugo,Janette	Undergraduate - BS: Biology	Senior
Magana,Claudia	Undergraduate - BS: Biology	Senior
McIntyre,Lauren Michelle	Undergraduate - BS: Biology	Senior
Miani,Jenna Renae	Undergraduate - BS: Biology	Senior
Moran,Randy William	Undergraduate - BA: Biology	Senior
Olivares,Jocelyn	Undergraduate - BS: Biology	Senior
Plummer,Sarai Ann	Undergraduate - BS: Biology	Senior
Ritchie,Kyle Andrew	Undergraduate - BS: Biology	Senior
Salice I,Ashley Megan	Undergraduate - BA: Biology	Senior
Santos Jr,Pedro Leonardo	Undergraduate - BS: Biology	Senior
Soriano,Stephanie	Undergraduate - BA: Psychology	Senior
Strother,Carl Philip	Undergraduate - BS: Biology	Senior
Toyama,Mason Robert	Undergraduate - BS: Biology	Senior

A selection of Student Reflections on the IRA funded Aquarium trip on 11/14/15 IRA Proposal #679

Student 1:

The Long Beach Aquarium had tons and tons of amazing things to see and learn about (literally, tons). One of the things I found most interesting was their water filtration system. Since almost all of their exhibits are based in aquariums they have to filter one million gallons of water every hour! To do this they use mechanical, chemical and biological filtration. Each type of filtration is targeted toward a specific waste product and handles it better than the other two could.

Mechanical filtration is used to remove solid waste. These filters range anywhere from sand to sponges. On our behind the scenes tour we saw foam being used as a mechanical filter. In foam filtration, air is pumped into the tank to form air bubbles, which then attract proteins and other waste products. This can simply be removed from the filter as the bubbles settle on the surface of the water. For each aquarium the mechanical filter used is picked depending on the quantity and size the waste is going to be. If the filter is too porous it lets too much waste through but if it is not porous enough the waste will clog the filter. This type of filter needs to be replaced regularly to stay effective.

In chemical filtration they inject ozone gas into wastewater. Since it is poisonous to animals this must be done in a separate tank than which the animals are living in. The ozone reacts with dissolved waste, bacteria and even parasites. It also will bubble to the surface and evaporate similar to the regular air filters. Due to its toxicity however, it must be removed before sending it back to the inhabited tanks, so a second chamber is used to allow the excess ozone to evaporate out of the water.

My personal favorite is the biological filtration system. This used living organisms to break down waste into less harmful substances in a natural way. We got to see the bio ball on our tour. This is a plastic ball, which bacteria can grow on and can be placed in the livable tanks with organisms. They also use the bio balls in their bio towers (which are basically large tanks of many bio balls that are used to filter more concentrated waste).

Student 2:

The field trip to the Long Beach Aquarium was very helpful in understanding just how complex marine ecosystems can be, considering that those recreated in the aquarium are much simpler than wild marine ecosystems. The work and effort put into the maintenance of the aquarium ecosystems is unimaginable, from the complex filtration systems built on site to the preparation of food for the marine animals.

The complexity of marine ecosystems recreated in the aquarium has given me a perspective of how complex wild marine ecosystems can be. The interactions between organisms are very closely related to the structure of the ecosystem. This complexity has helped in understanding how complex the marine ecosystem interactions can be for the grant proposal research that I have selected. A great deal of thought and preparation has to be put into the recreation of marine ecosystems, especially in marine animal interactions. This type of project can help understand the actual interactions between animals in wild marine ecosystems. Such

understanding can be applied to ecosystem restoration projects, such as what effects the removal of addition of an animal can have on the ecosystem.

The effort put into the cleaning the tanks is extraordinary, from the simple glass cleaning by the divers to the complex filtration systems put in place. Looking at the various tanks, I observed many of them being wiped down with cloths from the inside by many divers. The complex filtration systems were all built onsite and customized to fit the needs of the aquarium tanks. The system included a protein skimmer to remove any of the “beach foam” that one can see while on the waves while at the beach and any other protein waste in the tanks. Another filtration system component was the sand filter, which removed any waste product that settled on the sand of the tanks. The third component of the filtration system that caught my attention was the water filter, and their large size. This was used to filter the water in the tanks and was very large in size to accommodate the needs of each of the recreated ecosystem tanks.

The feeding of the aquarium animals was another large and complex task which took many people to carry out. As the tour guide mentioned, the animals are fed restaurant grade food, which is good to know that they are very well taken care of. It was also mentioned that between 100- 150lbs of food were prepared each morning depending on which animals were to be fed as not all animals eat every day. The most interesting were the three types of shrimp broth that were prepared and maintained alive on site. All three tanks were used up in one day, to feed all the “tiny” mouths of the aquarium.

Overall, the aquarium experience was a great one for understanding the amount of work that is put into projects of that scale. It was also a great opportunity to get informed about career and internship opportunities with NOAA and the aquarium for resume building and perhaps a change in career goals. It was a great experience that I hope future students also the have to opportunity to experience. One get gets the opportunity to view many other career possibilities that one may not have known about or considered prior to learning about them at the aquarium.

Student 3:

The Long Beach aquarium visit gave me a glimpse into the complexity involved in creating exhibits for the public to enjoy that are also well maintained for the marine animals. The behind the scenes tour was amazing, partly due to our tour guide’s expertise in careers related to marine biology, but also through seeing how different disciplines come together to take care of the marine wildlife. It was eye opening that one veterinarian and two veterinarian techs were responsible for over 13,000 marine animals. Likewise, the amount of food preparation they have to do for each animal is daunting, especially because it has to be of restaurant grade quality. By knowing how much work goes into generating an environment for the animals that is properly supported and safe, I now have an enhanced appreciation for aquariums and the science that goes into them.

We were fortunate to be able to see NOAA and our planet day, and I enjoyed meeting NOAA representatives. I feel like most of the general public is unaware of the impact NOAA has made in research and policy making related to the oceans. Now that I am a senior Biology major, I thought there was great benefit talking with the NOAA scientists

because I felt like I was able to have intelligent conversations about real issues facing our planet.

One of the booths sponsored by NOAA was Sea Grant. Sea Grant consists of 33 campuses across the U.S. and is committed to research and education in sustainable use of America's coast. A wonderful lady, Linda Chilton talked with us about overfishing of the rockfish and the success story of creating marine protected areas. I proceeded to ask her what she thought was the biggest issue facing the oceans today, to which she said ocean acidification and ocean warming. She talked about the ocean rising and how ocean modelers need help predicting the effects of this rise. Through photographs of incoming tides known as the "king tides", ocean modelers can accurately predict how the ocean rise will affect coastal communities. It turns out that the Ventura/Oxnard area is in need of volunteers to photograph these incoming tides on November, 27th and she asked that I raise awareness about helping this cause.

Since I was in high school, I've always wanted to make an impact and help our oceans, and I did that by voluntarily cleaning up plastic debris from beaches. Now that I am a college senior and I have more knowledge on other anthropogenic induced issues facing our oceans, I've been looking for new ways to get involved. This opportunity would be a perfect stepping stone into directly benefiting research for NOAA, while also meeting experts in this field. However, it is disappointing that I will not be in town on November, 27th to volunteer my time to do this. I will remain in contact with Linda for future dates in which I can participate.

To sum it up, the Long Beach aquarium trip was an eye opening experience that definitely made me think hard about my future career goals. Although I probably will not get into the field of marine biology, both this capstone course, and the field trip awakened within me the urgency of creating and maintaining a healthy ocean ecosystem. I will continue to look for new ways to volunteer my time as both a researcher in my spare time as well as raise public awareness to anthropogenic issues facing the oceans.

Student 4:

When I was a kid, I wanted to become a marine biologist when I grew up. I always watched Animal Planet and Discovery Channel and was fascinated with the ocean and especially with the animals that lived in it. Shark week (before it became commercialized, mockumentary filled pile of garbage) was one of my favorite times of the year because the shows interested me and was educational. It showed the beauty and power of sharks but also the need to protect them. My father, who works in the medical field, drove me away from marine biology because he wanted me to follow in his footsteps. He said that there are no jobs in the marine biology field. The biggest reason I took this section of capstone was my love for sharks and marine life and it has now made me reconsider what path I have planned for my future.

I went to the aquarium of the pacific at least once a year growing up and even more so after I was able to drive myself, but I never did a behind the scenes tour. This field trip was especially significant to me because I got to see things I have never seen at the aquarium before, but it also showed me so many jobs in the marine biology field are out there that I did not know existed. There are so many different pathways that can be taken, even in just the aquarium alone, that lead to different careers, and not only for marine science. Before the field trip, I assumed that the only jobs that you can

have at an aquarium is either taking tickets or cleaning the tanks. But going the behind the scenes tour showed me that there is much more going on in the back than out with the visitors, and this applies to other areas and fields, not just the aquarium. In addition to careers at the aquarium, NOAA staff were incredibly helpful with career paths and offered personal experiences.

I asked some of the people working the booths how they got to the position they are at NOAA. Those that had bachelors in biology had gone on different paths that led to NOAA. Although some people were volunteers, the majority of NOAA representatives were scientists or interns. Although I do not think I will end up working for a federal agency such as NOAA, I was comforted by the fact that almost everyone who I asked had a different career path and there was not one set pathway that one must follow to get to where they want to be. This field trip taught me that I should try to find and get as much experience as I can, even though it may not directly be related to what career I will end up having.

On a side note, an interesting fact that stood out to me was from a NOAA special agent. He said that they are starting to place tracking devices in fishing boats so they can see if boats are fishing in restricted areas as a means to prevent overfishing. This stood out to me because I thought it was difficult to catch boats that are illegally fishing in restricted areas and tracking devices makes this a lot easier.

Student 5:

When learning about the changing ocean in a classroom setting it makes sense to visit the closest aquarium; the Aquarium of the Pacific is located in Long Beach. The aquarium is home to 13,000 animals cared for by one veterinary and two veterinary technicians. By the tour guides descriptions, one in four of the people who you see are paid staff, the rest are volunteers. This truly speaks to the organization. I enjoyed our visit to the aquarium, but I think one aspect that could be strengthened is the education portion of the aquarium or perhaps because it was only my second visit and I am not a kid (target audience) I did not notice the educational point, but there are a lot of opportunities in which kids could have engaged more intimately with an educational volunteer. Perhaps, there is a lack of interactive education because of funding issues. Whatever the main reason is taking a good look around, there were no kids learning specifically about the basics of ocean acidification or climate change and that is a critical issue all animals and humans in the aquarium are facing in nature.

Southern California Coastal Ocean Observing System (SCOOS) representative said that El Nino is going to have massive effects on the ecosystem and they are working on data to help people in Cardiff and Seal Beach because it occasionally floods and is inundated whenever there are high tides. According to their website, “with rising sea levels and El Niño winters, it is crucial that a West Coast inundation model be developed for future safety and protection of coastal communities.” Considering that we have only begun to record and monitor water levels in the late 1970’s it is important to remember this area of research is in its infancy. These models can be done and then applied to other parts of the U.S West Coast.

Consideration of El Nino conditions, educating the public and engaging the public should be carefully taken into account because this can affect the lives of humans in the long run. Even though they cannot see the effects immediately, they are taking place.

The study of the ocean is something that is very important because it affects everyone. It also affects us in such means as survival in our everyday world. People need to be educated about the earth because it is their future. Who doesn't want a home along the beach? Will it be there in 30 years? When buying a house, majority of the population sees only what the house can offer. Not seeing what the effects are of the area that it is built in. This has taught me to look not only at the house itself, but the environment around it. Houses are meant to be something to shelter us from harm and keep us safe.

Reference: <http://www.sccoos.org/projects/cardiff-beach-erosion-inundation/>



This little guy could have learned about ocean acidification using litmus paper and basic chemistry or the diver could have held up a board with some sort of educational tip on it to provide a more interactive experience.

Student 6:

Last Saturday, 11/14/15, we were given the opportunity to visit the Long Beach Aquarium, and to tour the facilities behind the scenes that support the viability of the organisms and artificial environments on display. We were also given the opportunity to talk to aquarium employees and visiting NOAA scientists about career opportunities in marine biology, in both academia and the private sector.

The behind the scenes tour of the aquarium was very interesting, and taught me a lot about the amount of space and work devoted to water treatment. The water flow that serves as a "life support" for the aquarium animals requires treatment facilities of a larger volume than that contained in the exhibit tanks themselves. Approximately 1,000,000 gallons of water is present in the aquarium system. Water needs to be cleaned and aerated in the re-circulating system. Large tanks packed with sand, which resemble marshmallows for the large-scale exhibits, and serve as physical filters to remove some water contaminants. Ozone, a reactive molecule, is used to further cleanse the water (reacts with contaminants). Application of UV radiation to water allows more complete sterilization by killing most microbes present. A protein skimmer functions by disturbing the surface of the water, causing the formation of bubbles; proteins present in the water will denature under this process, and aggregate on the bubble surface, with a significant proportion of the proteins then adhering to and being retained on the side of the skimmer (this effect can be observed as the formation of foam caused by the wave action at beaches). The purified water is analyzed, through tests assessing Nitrogen levels, presence of



INSTRUCTIONALLY RELATED ACTIVITIES

C H A N N E L I S L A N D S

coliforms (usually an indication of fecal contamination), and the presence of any medication administered to animals, among other tests.

Additionally, I learned about the massive amount of work, both volunteer and paid, that is required to provide direct care, such as feeding and medical treatment, to the aquarium. The aquarium had only tens of paid members, but literally hundreds of volunteers fill a rotation to ensure that the animals are properly fed and cared for. Level III certification and extensive ecological/nutritional education is required for divers, who administer food (prepared by a volunteer force) to the highly diverse animals in various displays. Most of these highly qualified divers volunteer their time to support the aquarium. Classical conditioning is used to induce certain animals to respond to specific markers or stimuli, which will release or mark the release of the type of food targeted to those animals. The animal care department, which provides veterinary care to ~13,000 animals, is comprised of a single paid veterinarian, 2 paid veterinary techs, as well as a myriad of volunteers aiming to gain experience in marine biology and veterinary fields. The equipment required to support the animal care department includes light microscopes, a hydraulic table, special anesthesia systems that allow administration of anesthesia via water that flows over the gills of aquatic organisms, an autoclave for instrument sterilization, a radiograph, dental units, and many other instruments.

The behind the scenes tour and presence of NOAA scientists also facilitated exploration of possible career paths in oceanic and atmospheric sciences. Some of the scientists present deployed and ROV, or a remotely operated vehicle, in various specimen tanks to collect data and demonstrate how ROV's can be used to gather data in otherwise hard-to-access environments. This represents a promising intersection between the fields of engineering, computer science, marine biology/biochemistry, and oceanography, and resembles a procedure being developed by the CSUCI intertidal team to employ ROV's to collect population density and profile data in the low intertidal and subtidal zones, which are dangerous for researchers themselves to access. Another intersection between emerging technology and marine biology / oceanography is the ongoing effort to set up integrated observing systems along the length of the California coast. A network of various sensors can be used to collect data about wave height, temperature, pH, and other characteristics of water systems at various locations, and monitor how those characteristics change over time. This data can in turn be used to determine patterns in the response of various species to specific factors, to determine how sensitive certain taxonomic groups are to various environmental factors. The collection of this data also allows projections about how relevant ocean conditions might change in the future. The effort to set up integrated observation systems involves the collection of data from many sources, the transformation of that data into easily understandable information, and the sharing of that information between agencies and locations.

Representatives from SCCOOS, the Southern California Coastal Ocean Observing System, as well as from the Scripps Institute of Oceanography, discussed with students the difficulties encountered in accomplishing this transformation (from data to accessible information), the importance of technology

in allowing collection and sharing of this data, and strategies students might employ in determining their academic paths that would allow them to make relevant contributions to this field. For example, one of the representatives from Scripps described to students her experience as an undergraduate geography major, and how her technical expertise working with GIS (geographic information systems) was relevant and necessary in oceanographic fields, allowing her to pursue graduate work in oceanography. Other SCCOOS representatives discussed with students the importance of aquaculture development in a world where oceanic conditions in many important environments are expected to change faster than the organisms inhabiting them can adapt. Students were encouraged to look up information on COAST, the Cal State Aquaculture program. I personally was provided contact information for researchers at UCSB and USC currently collecting data on ocean acidification, as I was particularly interested in the availability of pH and/or pCO₂ data for marine environments near the Channel Islands. Additionally, students were provided with very specific tips to employ when applying for initial professional positions after graduation. For academic opportunities, students were encouraged to use phrasing directly from the ad or job description when describing their capabilities or qualifications.

Additionally, discussion with the tour guide who allowed our group access to the behind the scenes operation of the aquarium provided more insight into how to gain research opportunities. Her main piece of advice to students was to directly contact researchers whose work they find interesting, to ask for opportunities to assist in field work, and to be prepared to accept volunteer positions and to volunteer for the less interesting or more strenuous roles in the data collection process. These same She described her experience doing research in the Antarctic, which involved filtering water over long periods of time, collecting krill present for later analysis in the lab. Additionally, a piece of information that caught me by surprise was her reminding students that on the average research vessel, most of the crew members do not have, and sometimes are not working towards, PhD's. Given that most projects proposed by researchers with doctorates require the supporting work of many people, she assured us that there are opportunities for students without graduate degrees to participate in data collection and work in the marine biology field, though those roles likely involve collecting data under the direction of a researcher with a graduate degree.