# UNIVERSITY OF HAWAIʻI AT HILO

Marine Option Program Final Paper

## Education Outreach in Marine Science

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## Introduction

In 2001 STEM (Science, Technology, Engineering and Mathematics) was established in the United States to promote the importance of these subjects in schools. After determining students in the United States were behind in Mathematics, Science, and Technology, the National Science Foundation allocated funds and began a push for STEM-based curricula to be incorporated in to classrooms (Dugger 2007). A study by the Programme for International Student Assessment(PISA) indicated that the United States had a comparatively large proportion of underperforming students and that the country ranked 21st out of 30 countries on assessments of scientific competency and knowledge (Hallinen 2006). These results led to the introduction of STEM curricula across the country. With STEM in place, Next Generation Science Standards(NGSS) were introduced nationwide to meet the goals set by STEM. NGSS was developed in 2011 and was based on standards from countries with high performing science students (U.S. Department of Education, n.d.). The standards go deeper than just teaching science and math; NGSS urges the use of hands-on experience and focuses heavily on inquiry based learning (Alvarado et al. 2013). Educating the next generation using these rigorous science standards will determine the future of the United States (Next Generation Science Standards 2015, Marnicola 2006).

As science standards have improved nationwide, the required science background of educators has not. Specifically in K-8 classrooms, teachers have limited knowledge and limited resources to teach science (National Research Council 2007, McClure et al. 2017). Eighty-two percent of high school science teachers have a degree in science or science educationcompared to 41 percent of middle school science teachers and only 5 percent of elementary school teachers (Horizon Research Inc. 2012, National Academies of Sciences, Engineering, and Medicine

2018). Surveys conducted by Olson and Lobov in 2009 to determine the comfort level of science teachers based on prior knowledge all recorded low numbers, with only 16 percent of trained science teachers reporting feeling prepared to teach the subject (Olson & Lobov 2009, Dorph et al. 2007). Schools tend to fill science teaching positions in K-12 with teachers trained in general education (Anderman & Sinatra 2012). Some states recorded teachers spending sixty minutes or a less a week on science subjects because they reported not understanding the subject enough to teach it (Lewis et al. 2014).

Science courses often require more money to teach than other subjects due to their hands-on nature. They receive the least funding from school boards and tax dollars and are the most affected by budget cuts (Cayton & Jones 2018, Partelow et al. 2018, EB News 2018). Many schools have cited shortages in funding for STEM materials (National Science Foundation 2014, Jacques n.d.). Studies have focused on the issues associated with inadequate funding for materials, inappropriate or poor-quality instruments, a lack of any suitable spaces or infrastructure to be used for laboratories, or inadequate safety materials (Jacques n.d., Ejiwale 2013). These factors result in students being less engaged and underprepared for future STEM courses (Freeman et al. 2014). Aging equipment is also commonplace in classrooms, along with a shortage of funds available for maintenance or repairs and ever-shrinking budgets for replacement supplies (Tweed 2004). To efficiently learn science, students need safe laboratory classrooms and up-to-date science equipment and resources.

In Hawai‘i, particularly, underfunding is a problem. Hawai‘i schools are funded at the state level rather than from local taxes. The State Department of Education determines where funding will go with little input from local teachers (Akina 2018). On Hawai‘i Island, a push for better science standards has been made by teachers (Fujii-Oride 2019). Science teachers have

pushed for better funding to gain access to new equipment and field trip opportunities but remain underfunded because English and Mathematics are considered to be more important (Steinberg 2001). Local high schools science departments have access to outdated equipment, which does not prepare students to use current equipment for future science careers (McDonald 2015). Hands-on learning is an important way to gain knowledge (Freeman et al. 2014) and without access to field experience and equipment, students in Hawai‘i are missing opportunities (Steinberg 2001).

In an attempt to fill the gap of underprepared teachers and lack of resources I used my background in Marine Science to improve science education locally. As a student of the University of Hawai‘i at Hilo Marine Science Department I had access to materials and resources that teachers have difficulty accessing due to funding. The goals of this project were to provide hands-on educational opportunities for K-12 students as an educational outreach liaison for the Marine Science Department. My background gave me the ability to give students hands-on experiences and the opportunity to use tools currently used in the field including conductivity meters (YSIs), refractometers, and microscopes. I worked with local teachers in Hawaii and led their classes on field trips, brought them into the UH Hilo lab, and created activities for students to gain relevant information. Once the COVID-19 pandemic resulted in courses moving online, I transitioned to teaching online with schools in Alaska and California.

## Methods

### *3.1 Project Sites*

This project was conducted at two main sites, theUH Hilo Marine Science Department and Onekahakaha Beach Park. Figure 1 shows the lab at the University of Hawai‘i at Hilo

used for Onizuka Science Day, an event which is held once a year to give local students the chance to participate in science activities. The remainder of the activities were completed over Zoom.

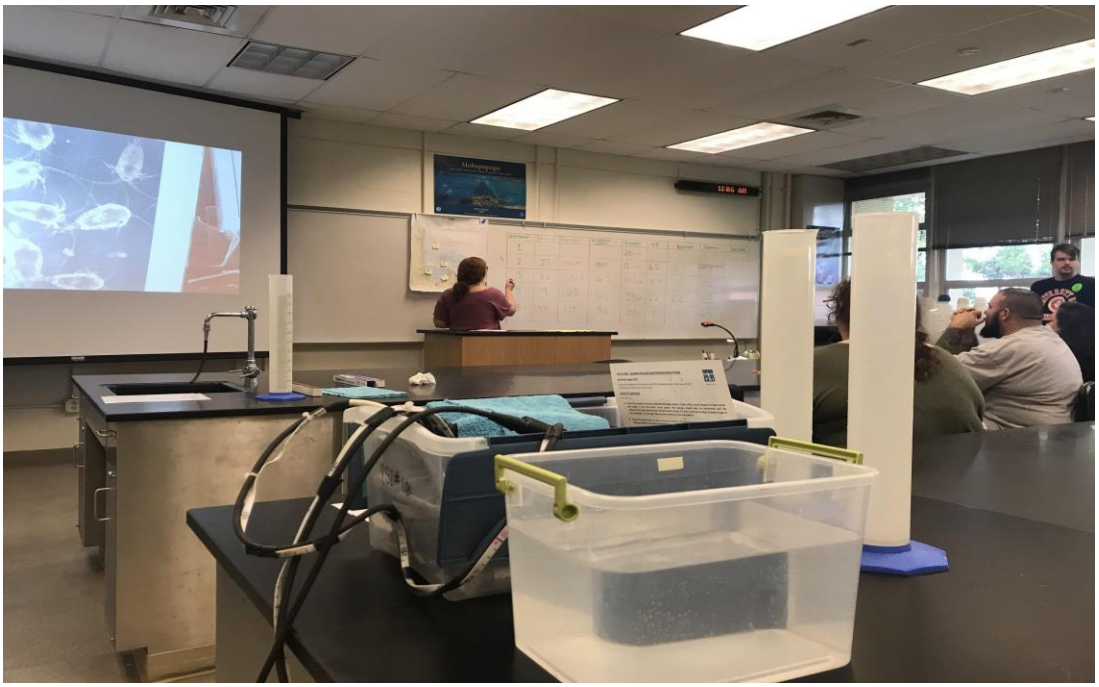

Figure 1. University of Hawai‘i Hilo lab.

### *3.2 Working with the schools*

Onizuka Science Day was my first education outreach project. Working with Lisa Parr, UH Hilo Marine Science Instructor and Site Coordinator for the Marine Option Program at UH Hilo, I planned and coordinated a marine science station where students were able to look at plankton samples and test water parameters and then decide where they thought water samples had been collected in Hilo Bay. This allowed me to work with multiple grade levels , 3rd through 10th, and required students to use critical thinking strategies while getting hands-on experience with lab equipment. After Onizuka Science Day I started working with individual teachers. Once lessons were approved by local teachers I scheduled times to complete the activities and field trips with classes. I was able to complete one field day with Kea‘au High School at Onekahakaha Beach Park where we tested different water quality variables including salinity, dissolved oxygen, and turbidity (Figure 2).

Figure 2. Using aYSI with students from Kea‘au High School to study water quality.

After the COVID pandemic broke out classes were transitioned online so all lessons were completed virtually. Working with one 4th grade class, one 5th grade class, and two 6th grade classes in California and Alaska, I was able to continue teaching marine science. I set up an interactive tide pool activity for the 4th grade class at Fortuna Elementary School to teach what a tide pool is, local species that inhabit it, and how to keep tide pools unharmed when visiting. After this I completed multiple small lectures and research projects with a fifth grade class and two sixth grade classes. I worked with my mom, who is a sixth grade teacher, and gave lectures on marine mammals, sea birds, and reptiles. Following these lectures, students created two group projects on seabirds and marine reptiles and one individual project on marine mammals. I demonstrated how to cite sources and find scientific journals that provided real data. Once students gathered their research information, students created presentations in poster format to educate the class on what they learned. Field trips were conducted with sixth grade students in Alaska as well.  Figure 3 is from a field trip to the Sea Life Center in Seward, Alaska with a sixth grade class from Soldotna Elementary.

I intend to continue working with local classes after the conclusion of this project, including leading tide pool field trip planned with a 4th grade class from Volcano School in the Fall of 2021, upon my return to the island.

Figure 3: Observing marine birds at the Sea Life Center with sixth grade students from Soldotna Elementary School.

### *3.3 Lesson Plans*

Following the Next Generation Science Standards(NGSS), I created lesson plans based on the standards for each grade level. All lessons were aimed at a topic of study specific to Hawai‘i, specifically Hawai‘i Island. When applicable, discussion on current issues in Hawai‘i was included in the lessons. All lessons included an activity for the students to keep them engaged and apply concepts to the topic discussed. Lesson plans were pre-approved and a date was set to complete the lesson and activity. Most lessons and activities took place in the field to give students hands-on opportunities, as well as allow them to use instruments commonly used in

data collection. I used my relationships with professors at UH Hilo to gain contact with teachers on Hawai‘i Island from various grade levels.

### *3.4 Evaluations*

Once activities with local classes were completed, teachers were asked to provide an evaluation or feedback on my ability to teach the lesson. I used this feedback to improve my teaching skills and lesson plans. Since the activities varied, I did not provide teachers with an evaluation form, but instead asked them to make notes or comments via email or directly on the lesson plans . I collated all evaluations and feedback and into a portfolio which I now have for future reference.

## Discussion/Conclusion

By completing my Marine Option Program project in education and outreach I was able to gain valuable experience that will benefit me as I pursue a teaching career. Working with teachers has given me the opportunity to improve my teaching skills, create better lesson plans, and create relationships that will benefit me moving forward. I now have classroom experience and a better understanding of the amount of work that goes into teaching a lesson. The feedback I received from teachers and students helped me improve my lessons and teaching skills. Teachers wrote evaluations based on content and execution and provided suggestions for improvement. Students also made comments and provided feedback on areas they felt could have been improved.

In the future I hope to complete plans made with local schools on Hawaii Island for additional field trips and in-class activities. COVID created an interesting situation where students went online and many teachers were not sure how to turn field trips into virtual activities. It also created an opportunity when I left the island because then I was able to teach at schools in California and Alaska. By doing this I worked with teachers from three different states and experienced how curriculum varies from place to place and how some subjects are

prioritized over others in certain areas. Working with the same grades, but in different states, helped me realize how a gap in science education is formed. The State of California pushes science standards equally to other subjects. In Hawai‘i, teachers want to improve science education for their students and are fighting issues of funding, but the execution of this subject was poor. The teachers I worked with in Hawai‘i had a passion for improving their students' science comprehension. In Alaska there were no science standards set by the state or districts. The teachers I worked with in Alaska brought me into their classes to expose students to science since many had not participated in activities and field trips before.

The teachers in Alaska, allowed me to take over their classrooms and introduce topics because they felt it was important but students weren’t required to know any of the information as per any state standards. The lack of science standards meant I could be creative with what I worked on with each class. I followed NGSS and then made the activities relate to marine life in Alaska because most of the students were unaware of the ecosystem in their backyards. Based on the lessons I completed, 4th grade students in California knew more about basic science principles then students in Hawaii and Alaska at the middle school and high school level. In my opinion, this says a lot about science education nationwide if it could be this drastically different among states. While there are more factors influencing science education nationwide, establishing nationwide standards for science should be discussed. At Soldotna Elementary in Alaska, there are no science standards, and that is true for the entire state of Alaska. STEM standards aren’t incorporated into any curriculum so the only way students get science education is, alarmingly, when teachers create their own.. Every class I worked was full of students who were excited to learn about marine science and were engaged the entire time. I do not believe that the issue is students not wanting to participate in science; it comes down to state standards, district standards, and funding.

Since completing this project I hope to continue working with schools while I finish my undergraduate degree and begin pursuing my graduate degree. I plan to be based in Alaska for my graduate degree and hope to use my knowledge and experience to continue helping students receive science education and get them interested in science.

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