Report to the University of Hawaiʻi at Hilo Marine Option Program

Educational Outreach Coordinator Internship

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Abstract:

As a university with many science specialties there are many requests for outreach events for K-12 students to engage with undergraduate programs. The marine science department at the University of Hawaii at Hilo receives several requests a year for K-12 students to visit the department. Additionally in the several years the teaching marine science (MARE 434) class has been taught an abundance of student created lesson plans have been accumulating. As a result my project was to revise and create an electronic copy of student created lesson plans for future use at outreach events or for use in local school classrooms.

Introduction:

Science literacy, in its many forms, is important for many aspects in life but the often ambiguous definitions associated with this term makes understanding its purpose difficult. Many definitions acknowledge there are two sides to scientific literacy. The first being the ability to read and write science in a way that shows understanding of basic vocabulary (Norris & Phillips 2002; NAP 1996; Webb 2010; Yore et al. 2006; Fisher et al. 2009). The other side is having the knowledge, experience and education to understand the processes and concepts of science research (Norris & Phillips 2002; NAP 1996; Webb 2010; Yore et al. 2006; Fisher et al. 2009). For the purpose of this paper I will refer to science literacy as the understanding of science concepts (NAP 1996; Norris & Phillips 2002).

With continued advancements in STEM fields and politics involving scientific findings there is a need for a scientifically literate population; however, many difficulties are faced in the process of teaching K-12 students science literacy (Liu 2009; Medina et al. 2014; Priest 2013; NAP 1996). This difficulty is reflected in the Program International Student Assessment (PISA) test provided to 15 year old students in 64 countries (NCES 2015). On this test the United States scored lower than 22 educational systems on the science literacy section alone and only 35 on the overall test (NCES 2015). From these results is it apparent that improvements need to be made in K-12 classrooms to create scientifically literate adults in the future. It has been proposed that engagement in experiences where discussion, planning, and practicing science concepts will provide students with an understanding of scientific research (Reveles et al. 2004; Webb 2010). Through this process both formal and informal educators will be able to model what it means to be scientifically literate in a way that promotes further understanding of science concepts (Norris & Phillips 2002; Fisher et al. 2009). One way this can be achieved is through the use of outreach programs hosted by university students who are working on their own research projects.

Examples of such outreach programs can be observed at large universities like Washington University in St. Louis and the University of Oregon (Beck et al. 2006; Pluth et al. 2015). Both programs encourage undergraduate and graduate student participation in various outreach events with local middle and high school. The Young Scientist Program (YSP) involves medical school students assisting local high school students and their teachers (Beck et al. 2006).

This program also includes an eight week internship that 12 high school students are accepted to yearly and involves writing a formal research paper (Beck et al. 2006). The University of Oregon's Chemistry and Biochemistry Department created their outreach program when local middle and high school science funding was decreased (Pluth et al. 2015). With increased results programs like these would be beneficial in smaller areas like the University of Hawaiʻi at Hilo (UH Hilo).

The implementation of an outreach program on the UH Hilo campus would be beneficial due to the fact that many courses produce lesson plans and research projects specific to the Hawaiian Islands. Within the Marine Science Department the Teaching Marine Science (MARE 434) and the Marine Field Experience for Teachers (MARE 435) courses are focused on teaching marine science while creating unique lesson plans. Both courses produce several lesson plans and in the seven years they have been taught they have been filed away.

Over the course of seven years the large quantity of lessons created from the MARE 434 and MARE 435 courses that have been stored away. Due to the copious number of requests for outreach events hosted by the UH Hilo Marine Science Department these lessons can be used to assist local K-12 teachers as well as at on campus outreach events. The basis of this project was to create an electronic database of previously created lesson plans that have been reviewed and edited for utilization outside the Marine Science Department. Additionally I created a Live Tank Activity that was used at the 2016 UH Hilo Earth Day event.

Methods and Materials:

Outreach Lessons

As a result of the teaching marine science (MARE 434) class students must create lesson plans in many different science topics. These lessons are then used by the students within local classroom settings and saved by Lisa Parr for future use. Due to this fact, an accumulation of many years of lessons has been stored. As part of my project I took this collection of lesson plans over winter break and reviewed them making notes for possible improvements. Starting the project I received approximately 108 lesson plans ranging from well written to some that needed slight improvements. After I had completed taking notes on these lessons I narrowed the pile down to approximately 80 lessons that had a good concept, written in a way that teachers would easily be able to revise for their own purposes, and made suggestions for those that could benefit from slight adjustments. Following this, I then sorted them into manila folders with the title of the lesson, the author of the lesson, and keywords.

Electronic Database

As a part of this position my goal was to make the lessons created through the Marine Science Teaching class accessible to local teachers that would like to apply marine science concepts in their classrooms. While the lessons mentioned above have been taught in the classroom as part of the overall MARE 434 class, the teachers may not have had access to them after it had been taught in the classroom. The information provided by the lesson itself contained the title, author, grade level and length. In the reviewing process I kept a list of the lessons, the associated keywords, and lesson type. This information was used to create a comprehensive and user friendly Excel spreadsheet.

Once a list was created with all lesson information it was transferred to an empty 8-gigabyte flash drive. The 80 lessons were scanned onto this flash drive with as little access unnecessary information as possible. Since these packets were part of a class project many of them included additional information that was not a part of the lesson itself. As a result the use of a thirty-day trial of Adobe Acrobat was used to delete non-related information and to separate lessons that were double sided documents. These files were saved as a PDF file and separated into three folders within the flash drive memory. The folders are labeled as elementary school, middle school, and high school.

Live Tank Activity

Once a year UH Hilo hosts a comprehensive outreach event with multiple school groups in attendance. The Marine Science Department typically hosts two activities on campus with one for younger students and another for middle to high school students. For the spring 2016 Earth Day event I organized a Live Tank Activity for younger students. This activity was designed to maximize undergraduate and student interaction without organism mortality. For participation in this activity a sheet was created with nine clues to help students identify organism adaptations (Appendix 2 & 3). The entire event spanned from 9am to 2pm with student volunteers alternating every two hours.

Results/Discussion:

Outreach Lessons

Beginning this project was time consuming due to the volume of student written science lessons. In total I spend approximately a month and a half reviewing and making notes on lessons. Due to repeating concepts and quality of the lesson I then decreased the number that would be later scanned. Overall the lessons from this class were well written, easily understandable, and accurate. The only other portion of this project was organizing the lessons post scanning.

Electronic Database

Initially I was going to create an electronic and a paper copy of all lessons used. However, it became evident that economically a paper copy of the lessons was not feasible. The electronic database was easy once all of the lessons were recorded in the Excel spreadsheet on the Outreach flash drive. Scanning the lessons on to the flash drive was simple and took approximately two hours. After these lesson plans were scanned onto the flash drive as a PDF it was simple to make edits to them with the use of Adobe Acrobat. In some cases there were two lesson plans that were printed double sided and therefore needed to be separated. There were also several packets of lesson plans created by one author but were created for different age levels, in which case these lessons would be separated then saved as two separate PDF files. The whole process of editing these portfolios took approximately four hours. In total this portion of the project was simple.

Live Tank Activity

Originally as a part of the student interaction for this event a sheet with nine clues about the organisms held in live tanks was created by another Marine Science student and myself (Appendix 2). Due to the assumed grade level of the students attending this event, the clues were fairly simple. For example one clue was “I use my mouth and spines to create my home in a rock” refers to a rock boring urchin. As groups of students stopped at the station it was apparent that most were not carrying a writing utensil. At this point the volunteers then began having a discussion with the students stopping at the station. Unlike previous years, this year it was decided to use organisms in tanks without allowing the organisms to be handled. This appeared to be a beneficial method in both allowing organisms to remain unstressed and a conversation to be held with larger groups of students.

Throughout the day many marine science volunteers were scheduled to work at one of two activities with overlap for an hour. During the day of the event I had a few students who withdrew their participation and in some cases only minutes before they were supposed to be at the activity. Part of this issue was created due to a tardy response as to when they were expected to be at the event. However, it was assumed that some would not be able to make their appointed times and the overlap of volunteers allowed for flexibility in timing. One suggestion I would make is that an incentive should be used for students to commit to volunteering. A professor within the marine science department offered extra credit for her students participating in any part of Earth Day and all showed up.

Overall the Live Tank Activity at Earth Day appeared to run smoothly and be beneficial for the school groups in attendance. However, for next year I have a few suggestions in order for the event to run more smoothly. First, I would suggest early planning. Due to time constraints I was unable to plan the event with as much detail as would have been beneficial. Allowing for extra time in planning could result in two activities involving live organisms to be conducted concurrently. Also, I would suggest the use of two showing tables in the next Earth Day event. This would allow for the use of four additional tanks with organisms to be displayed. However, this suggestion would also increase the number of volunteers needed to supervise the activity. This set up would require at least four to five volunteers at any given time in order to ensure the students are not handling the organisms. The use of eight tanks would also require an increase to the number of organisms collected. Also, I found the use of live tanks without allowing students to handle the organisms to be the best route. This allowed for the students to observe the organisms, interact with the volunteers and keep the organisms from dying. Finally, in the collection of organisms displayed early planning would allow time for unexpected issues. It is my suggestion that two weeks prior to the event the initial collection should be conducted and another collection the week before. Not only will multiple collections allow for more organisms to be shown but it will provide time if they are removed from the tanks without the knowledge of the Earth Day coordinator. In this case it would be wise to reserve the use of one tank within Wentworth 4 for the specific use for Earth Day. However, if time allows a count of organisms the morning before the event should be conducted. I found that removing the organisms the night before into separate tanks allowed for a simple transport to the station location. A shift in location would also be wise due to the background noise from the plaza.

Conclusion:

The process of reading and editing lesson plans from MARE 434 students was very beneficial. In the duration of this project I read approximately 108 lesson plans and of that 80 were used for outreach material on a flash drive. The concepts within these lessons were not just important topics but they were demonstrated in a unique way that would be beneficial in most local classrooms. I found that the process of scanning and editing the PDF files to be quite simple once the information I needed was extracted from the lessons themselves. However, this task was more time consuming than I initially believed it to be. Overall this experience was educational in my future instruction in a biology classroom.

The process of planning and executing Earth Day was more complicated than I had thought it would have been. Due to the success of having live animals at previous Earth Day events, this year it was requested again. Once change we made was not allowing the students to touch the organisms on display. This approach seemed to be beneficial for both the students and the organisms. During the day there were a few issues with marine science students not showing up or sending notification minutes before they were supposed to be at the event. Even with these issues I found that the event ran smoothly.

After participating in this project I found that outreach programs at universities should be a common occurrence. In such events undergraduate students, of any degree path, can interact with younger students in a context that allows both to gain knowledge. Undergraduate students are able to accurately and, in some cases, delicately explain an area of their studies. On the other hand younger students are able to experience the different aspects of learning after high school graduation.

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Appendix 1: Lesson Plan Master Excel Sheet

Lesson Title	Author	Grade Level	Approximate Length	Lesson Type	Keywords
Euthropication	Michael D'Amico	4	60	Activity	pollution, nutrient limitation
Nutrients are Important	Michael D'Amico	4	15-20	Activity	Nutrient limitation, cycling
Hawaiian Spinner dolphin echolocation	Vera Sonnenberg	2-4	20-30	Activity	adaptation
Fashion a Fish	Tiff Devine	2-5	60	Activity	adaptation
Whats my Adaption	Jennifer McDonald	3	15-20	Activity	identification, adaptation
Predators and Adpatations	Nicole Tachibana	3-6	30-45	Activity	food chain
Fish Naming		5	20	Activity	identification, adaptation
Whale identification	Heather Forester	6+	60	Activity	technology, identification
Atoll Zonation	Margaret Homerding	6+	20	Activity	plate tectonics, envrionmental conditions, communities
Fish Identification	Emilee Holmes	6-8	30	Activity	adaptation
Food webs of Hawaiian reef ecosystems	Vera Sonnenberg	7-8	20-25	Activity	food chain
Ocean motion	Vera Sonnenberg	8	20-25	Activity	waves, predictions
Animal Classification	Lacey Price	8-10	30	Activity	taxonomy
Whats in a name	Aleui Lyman	9-10	30	Activity	taxonomy, dichotomous key
Navigation Activities		9-12	60	Activity	navigation, culture, compass
Deep-sea hydrothermal vents	Ranae Nitura	Early elem - middle school	35	Activity	adaptation
Craft a Honu	Ivy Patton	k	20	Activity	culture, hazards
Silent Fish	Ivy Patton	k	10	Activity	adaptation
Wiggly Whales	Ivy Patton	k	10	Activity	adaptation
Ocean in a bottle		K-2	20	Activity	waves, water parameters
Seawater and Freshwater		K-2	30	Activity	water properities, density
Whale blubber		K-2	15	Activity	adaptation
Fish Hide-n-Go Seek	Crystal Chavez	k-5	20	Activity	adaptation
Mid-Ocean Magnetism	Megan Broadway	3-6	20	Activity	plate tectonics
Trophic Structure		4-5	60	Activity	food chain, bioaccumulation
Pollution Solution		5	12	Activity	oil spills, cost analysis
mock HI monk seal management plan	Melissa Netze	8	30	Class Debate	local opinion, ecological management
The future of farming	Alex Gerken	9-12	Semester Long	Class Project	aquaculture, water parameters
Kaukau? But How? Pt 2	Nicole Tachibana	1-3	30-60	Classroom Game	behavior, adaptation
"Fuzzies"		10-12	60	Debate	conservation
Which place is better	Erin Kawakami	6	60	Field	transects, graphing, abundance

Organism Density at Onekahakaha	Carla Konz	5-8	60	Field	transects, data collection, graphing
Marine Fish Behavior	Heather Forester	6+	60	Field	identification, data collection
Substrate Survey	Rebecca Weatherall	6-8	25	Field Lab	percent cover, quadrats, graphing
Bioaccumulation	Anna Chase	4	60	Game	food chain, energy transfer
Fishing for a living	Erin Kawakami	6	60	Game	food chain, overfishing
Sustainable fishing	Megan Broadway	3-6	25	Game	technology, consumption
Plate Boundaries	Megan Broadway	6	25	Game	plate tectonics
Marine Debris	Megan Broadway	k-2	25	Game	hazards
Sustainability	Lacey Price	k-3	30-45	Game	fishing practices, human impacts
Fishy	Tiff Devine	k-3	60	Game	identification
Hawaiian Fishing	Ranae Nitura	Prek	30	Game	overfishing
Endangered and threatened species	Lacey Price	prek-3	30	Game	identification
Chlorine in the ocean	Anna Chase	4	60	Lab	water parameters, data collection, graphing
Dissolved oxygen	Anna Chase	4	60	Lab	photosynthesis, water parameters, graphing
Photosynthesis	Anna Chase	4	60	Lab	respiration, pH
Watersheds	Anna Chase	4	60	Lab	pollution, Hilo Bay
Watersheds & pollution accumulation	Anna Chase	4	60	Lab	pollution
Discovering plankton	Michael D'Amico	4	60	Lab	food chain, experimental design
Monsters of the deep	Richard Pierce	5	60	Lab	adaptation, water parameters, identification
Buyonancy	Nick Seferovic	1-2	15-20	Lab	density
Which is denser?	Jennifer McDonald	3-4	25	Lab	water properities, density
Marine Debris	Lacey Price	3-6	30-60	Lab	pollution, hazards
Pollution	Nick Seferovic	5	60	Lab	density, effects, oil spills
Planet Earth	Richard Pierce	5	60	Lab	tectonics
Invertebrates		5	20	Lab	identification, touch tank, predictions
Analyzing, preserving and identifying seaweeds	Lea Carrico	5&6	45	Lab	microscope, identification, culture
edible gel from seaweed	Lea Carrico	5&6	30	Lab	algae uses, chemical processes
Oil Pollutions and Broken Wings	Emily Lin	5-6	20	Lab	microscope, oil spill
Water Density	Carla Konz	5-8	25-30	Lab	predictions, stratification
Building Paper Bridges	Luke McKay-Jones	5-8	15	Lab	experimental design
The Role of Plants/Aquatic Ecosystems in Water Filtration	Ashley Heard	5-9	60	Lab	watersheds, pollution
Bouyancy and Weight Displacement	Jon Bjornen	6	45	Lab	density, water properities, experimental design
Beach Debris	Heather Forester	6+	25	Lab	data collection, abundance, graphing
Sands of the Big Island	Margaret Homerding	6+	45	Lab	geological processes, data collection

Fish and Buoyancy	Emily Lin	6-8	25-30	Lab	adaptation
Whales	Marcianne Brokaw	6-8	30	Lab	plankton, adaptation, experimental design
Is My Coral Reef Healthy?	Tiff Devine	6-8 or 5-6	45	Lab	data collection, hazards
Sinkers and Floaters	Ethan Hongess	7-8	25	Lab	density, buoyancy
Electricity and Water	Luke McKay-Jones	7-9	25-30	Lab	experimental design, water properities, data collection
Paper chromatography	Alex Gerken	9-12	45	Lab	data analysis
Hawaiian Marine Ecology	Jon Bjornen	9-12	60	Lab	food chain
Limu Herbarium and Human Consumption	Ranae Nitura	Prek	35	Lab	identification, preservation
RIP/Scientific Method	Anna Chase	4	60	Lab/Discussion	observation/opinion, variables
monk sea limiting factor	Melissa Netze	8	30	Outdoor Game	reproduction, food chain, hazards
Kaukau? But How?	Nicole Tachibana	prek	30-60	Outdoor Game	culture, adaptation, identification
Echolocation	Nick Seferovic	5	60	Outside activity	adaptation

Appendix 2: Live Tank Activity Clue sheet and answer key

Clues	Species
I use my mouth and spines to create my home in a rock	
My house is a shell but it is not mine	
I'm most active at night but you don't want to touch me	
Unlike my cousins I walk with my arms and not tube feet	
When I feel threatened I spray water out one end	
My shell has been used as currency, dice and jewelry	
I am dome like in shape with side wing-like extensions	
Endemic to Hawaii, I am an important inhabitant of coastal anchialine (brackish) ponds	
I may look pretty but you don't want to touch me, my color is to ward of predators	

Clues	Species
I use my mouth and spines to create my home in a rock	Rock Boring Urchin
My house is a shell but it is not mine	Hermit Crab
I'm most active at night but you don't want to touch me	Wana
Unlike my cousins I walk with my arms and not tube feet	Brittle Star
When I feel threatened I spray water out one end	Sea Cucumber
My shell has been used as currency, dice and jewelry	Cowrie
I am dome like in shape with side wing-like extensions	Box Crab
Endemic to Hawaii, I am an important inhabitant of coastal anchialine (brackish) ponds	Opae'ula Shrimp
I may look pretty but you don't want to touch me, my color is to ward of predators	Fire Worm

Appendix 3: Live Tank Activity Set Up