

K-12 Exposure to Water Quality, Treatment, Resources and Management at the Florida Aquarium as an Outreach Activity During a Large Professional Conference

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Abstract – In May 2007, the Environmental Water Resources Institute (EWRI) sponsored an outreach activity as a part of the congress held in Tampa. The main objectives of the activity were to increase awareness of K-12 students on issues related to water relevant to living in Florida, and to broaden participation of students in STEMs fields with an emphasis on environmental engineering. It was held at the Florida Aquarium and targeted a total of 125 elementary, middle and high school students from the Tampa Bay area. Four schools participated and the day's activities were divided based on the grade level group with volunteer mentors from the Congress, local professionals, and USF and assistance from the aquarium staff. Undergraduate volunteers mentored elementary students whilst professional engineers and faculty volunteers mentored the older students. Student surveys suggested that students left with a better understanding of the water related concepts covered and the environmental engineering profession.

Keywords: K-12, Water, Outreach, Environmental Engineering, STEM, EWRI.

INTRODUCTION

The Environmental and Water Resources Institute (EWRI), an institute of the American Society of Civil Engineers (ASCE), held its annual congress in May 2007 in Tampa, Florida under the theme “Restoring Our Natural Habitat.” Nine months prior to the Congress a group of professional and academic volunteers agreed to form an outreach committee for the congress, marking the first ever activity of its kind for the meeting. The Congress was held in downtown Tampa, home to the Florida Aquarium (<http://www.flaquarium.org>), a well established landmark showcasing various Floridian ecosystems with multiple educational activities of its own. The EWRI approved the

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first outreach activity during the conference given Florida's diverse habitats that require protection and, in some cases, restoration. The Outreach Committee, co-chaired by faculty at the University of South Florida (USF) was responsible for planning and execution of the activity and with the advice of aquarium staff decided to target K3-12 students of Tampa bay schools and hold the activity at the Florida Aquarium which was within walking distance to the congress. The underlying goal of the activity was to inspire and encourage students to pursue careers in engineering with a particular emphasis on broadening participation in environmental fields and applications. Four schools were identified and invited to participate (two elementary, one middle and one high) by the USF Director of Engineering Student Services, Recruitment and Retention. Mentors were recruited through the EWRI Congress website, conference registration material and emails to various student groups and professionals in the Tampa bay. Student mentors were offered a one day pass to the conference.

OVERVIEW OF THE OUTREACH ACTIVITY

Planning

With the venue and participating schools decided upon, the committee members had to design specific activities that were within the conference's theme. Time limitations had to be considered as the schedule had to fit in with the regular school day. Space also had to be considered given the classrooms, lecture halls and exhibits at the aquarium site. They also had to seek mentors for students on the day as well as to prepare supplementary materials for teachers and students to be able to continue the discourse in their classroom after the event. After the budget was prepared funding was obtained from EWRI and through a SPAG grant from the Florida Section of ASCE, and the West Coast Branch. This funding was used for chartered buses, food, materials for lessons, T-shirts for mentors, and the printing of student, mentor and teacher certificates. ASCE Florida Chapter members and student chapter members of ASCE, Engineers for Sustainable World and American Water Works Association were invited to assist along with faculty from Civil and Environmental Engineering departments from Florida's universities. This approach allowed for a variety of persons to partake – from undergraduate civil and environmental engineering students, to faculty, to professionals in the field – and interact with the participants.

Table 1 summarizes the objective for each school level and the mentorship pairing utilized. All of these arrangements were solidified through a nine month planning period, during which there were regular meetings of the Outreach Committee. Chaperones were assigned to ride on each bus along with the student participants. A pre and post activity survey was administered on the bus ride.

Table 1: Overview of Mentoring Objectives by Student Level.

Student Mentee Group	Objective of Activity	Preferred Mentorship
50 elementary (ended at 12:30 pm)	Students were from grade 5 in Title 1 schools and this was an opportunity to broaden participation in science/engineering.	University undergraduate and/or graduate students
50 middle school (ended at 1 pm)	Students selected were in the civil and environmental engineering track and this was used as an opportunity to further encourage them to continue in the discipline.	Graduate students and/or professionals, faculty
25 high school (ended at 3:30 pm)	Students were in environmental science class and the activity was an opportunity to let them interact with professionals in the field.	Professionals and/or faculty

Activities

Once the students arrived at the aquarium they were led into there separate rooms where they were placed into groups with their mentors and got ready for their first activity, all according to a carefully crafted schedule as shown

Elementary		Middle			High	
Belle Witter	25	Dowdell	25	25	Middleton	25
Lockhart	25					
Chaperones	6	Chaperones	3	2	Chaperones	3
Mentors	18	Mentors	8	7	Mentors	10
Total	73	Total	36	34	Total	38
<i>Time</i>	<i>Activity</i>	<i>Time</i>	<i>Activity (gp1)</i>	<i>Activity (gp2)</i>	<i>Time</i>	<i>Activity</i>
8:00	pick up Belle Witter				8:30	Pick up Middleton
8:40	pick up Lockhart	8:30	pick up Dowdell	pick up Dowdell	9:00	Arrive Aquarium-mentor
9:00	Arrive Aquarium	9:00	Arrive Aquarium	Arrive Aquarium	9-9:45	Behind the Scenes
9-9:30	Mentor pair up	9-9:30	Mentor pair up	Mentor pair up	9:45-10:45	Lesson M2
9:30-10:30	Lesson E1	9:30-11	Stormwater	Behind the Scenes	10:45-12:30	Fantasy Island
10:30-10:45	Snack	11-11:15	Snack	Snack	12:30-1	Lunch (on boat)
10:45-12	Lesson E2	11:15-12:30	Lesson M1	Lesson M2	1-2:30	Exhibit Hall
12-12:30	Lunch	12:30-1	Lunch	Lunch	2:30-3:30	Wrap Up
12:30	Depart	1	Depart	Depart	3:30	Depart

in Table 2.

Table 2: Schedule of Outreach Activities with targeted number of students, chaperones and mentors.

Lesson E1 began with an explanation of the usefulness of mangroves to the environment and the need to protect them as well as the different types of mangroves, with emphasis on those present in Florida. Armed with this theory the elementary students were taught hands-on how to pot mangrove proggules before their lesson culminated in a tour of the Wetlands Exhibit at the aquarium. The potting segment was led by the resident horticulturist at the aquarium. After a short snack break Lesson E2 commenced where the elementary kids were taken to the adjacent

stormwater pond for collection of water samples for simple analysis. A commercial test kit was used to raise awareness of, and test for pH, total nitrogen, phosphate, turbidity and temperature. The students were taught the importance of monitoring each of these parameters. The opportunity was also seized to discuss the effect of plankton and eutrophication on the condition of the pond.

A city representative from Tampa's "Adopt A Pond" program was invited by the aquarium staff to lead a lesson for Group 1 of the Middle school students on stormwater and how it should be treated during a stormwater activity. This led to discussion of large scale capture and treatment at the county level as well as the need to meet certain levels for different parameters as mandated by legislature. The nearby stormwater ponds were sampled and provided a visual aide in understanding some concepts. The grab samples taken were utilized in Lesson M1 for simple water quality testing. Tests were done for phosphate content by the vanadomolybdate method and use of spectrophotometers as well as pH and conductivity with respective meters. Commercially available test kits were also used to test for some water quality parameters. After this the students were introduced to the concepts of coagulation/flocculation through the use of bench top batch mixers and the use of alum as the manipulated variable for visual impact. The also examined the effect of sand filtration on water quality.

The second group of Middle school students as well as the High school students started their activities with the Behind the Scenes Tour of the aquarium. This tour took the students through all of the processes involved in running the aquarium with a focus on the water treatment processes needed to purify the salt water that is shipped from the Gulf of Mexico as well as potable water treatment for freshwater exhibits. Students were given sample bottles to collect water from some of the exhibits. The students then proceeded with Lesson M2 which was a laboratory activity that mimicked the water treatment processes at the aquarium. The model created for saltwater tanks included sand filtration, ozonation as well as aeration while that for the freshwater tanks allowed tap water to be passed through granular activated carbon columns for chlorine removal. These models were built by members of the Outreach Committee and volunteers and are shown in Figure 1 along with an existing model at the Florida Aquarium that is seen during a Behind the Scenes Tour. Students were able to test water quality parameters of their exhibit samples as well as from different points in the laboratory models. pH meters, a HACH chlorine test kit, as well as test strips available in aquarium stores were used. Directly after Lesson M2 the High school students were led in a mangrove planting exercise led by Aquarium staff. They were boated to nearby Fantasy Island where the importance of mangroves and their use in natural systems were conveyed before each student was allowed to plant at least six spartina plants and then sample for critters. After lunch on the return boat ride they were led to the conference's exhibit hall where they were able to liaise with exhibitors. They were asked to participate in a scavenger hunt with the clues based on the exhibits and designed by one of the Outreach Committee graduate student volunteers who had contacted the exhibitors.

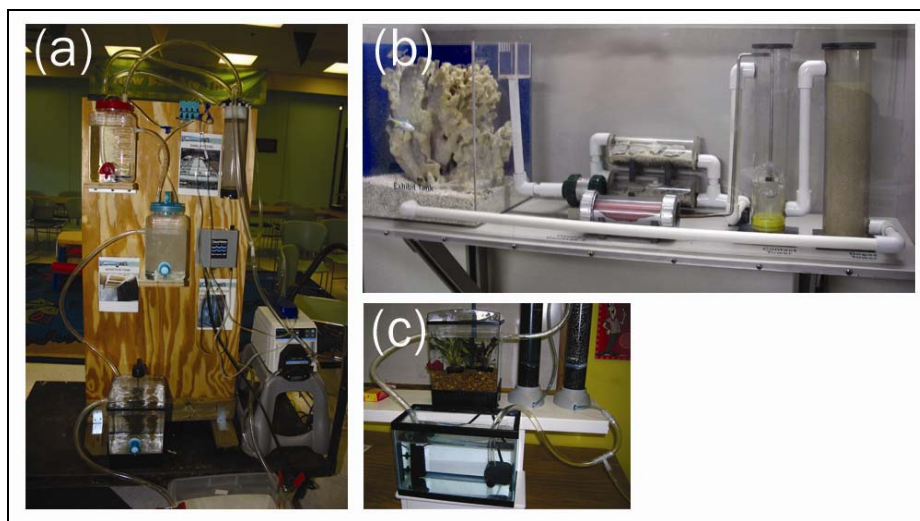


Figure 1: Pictures of models used for lessons on Water Treatment Processes. (a) Model for Lesson M2 salt

water treatment, (b) Miniature non-interactive salt water treatment model located at the Florida Aquarium, (c) Model for Lesson M2 for tap water treatment.

EVALUATION AND ASSESSMENT

Expected learning outcomes were set by the organizing committee for the different school levels and this formed the basis of the assessment. The evaluation was done by the use of simple level specific surveys. All students were given their respective questionnaire (Table 3) on the morning of the event which was completed prior to arrival at the aquarium. At the end of the outreach activity students were given the same series of questions in an effort to gauge what was learnt. Note that all the questions were yes or no type questions and were the guide for mentors to lead their discussions during the entire activity. Enquiry based learning techniques were also utilized during the activities.

Table 3: List of Questions on the student participant surveys. (Morning and Afternoon Surveys)

Elementary School Level

- Do you follow any technique to purify at home or at school?
- Do you know the meaning of an estuary?
- Are you aware of the government regulations to protect the environment?
- Are you aware of what civil and environmental engineers do?
- Are you aware of techniques to make water potable (drinkable) in case of an emergency?
- Are you familiar with what a mangrove is?
- Will too many nutrients affect a storm water pond?
- Do you know the steps involved in the water cycle?

Middle School Level

- Are you able to identify the types of mangroves that grow in Florida?
- Do you know the pros and cons of storm-water runoff?
- Have you heard of the term sustainability in relation to water management?
- Are you aware of what civil and environmental engineers do?
- Do you know the purpose of filtration?
- Do you know how to measure water quality parameters like pH, hardness and turbidity?

High School Level

- Do you know why mangroves are important to coastal areas?
- Does ozonation disinfect water?
- Are you aware of some of the processes used during water treatment?
- Are you aware of what civil and environmental engineers do?
- Do you know how to measure water quality parameters like pH, hardness and turbidity?
- Are you familiar with the effects on the quality of life in a watershed when the water is polluted?
- Do you know what kinds of companies hire people to work on issues related to water and the environment?

The results of the outreach surveys showed that at every school level the students left with a much better understanding of water quality, treatment, resources and management than they had arrived with. Some typical results attained from the Middle school are shown in Table 4. The total number of students completing the surveys in the afternoon was less than that number in the morning, however, the percentage of students exhibiting a better knowledge of the survey questions in the afternoon was much greater than that in the morning.

CONCLUSIONS

The outreach to expose K-12 students to basic environmental engineering concepts as it pertains to water was deemed successful based on the evaluations. For student, and teacher participants alike, it provided a valuable opportunity to experience environmental engineering first hand. For the teachers present many said they were able to get ideas for use in their classrooms to teach about water issues and have sought assistance for follow up activities in their own classrooms. Many of the participants showed enthusiasm towards civil and environmental

engineering. The activity took advantage of a unique opportunity where a large number of professionals in fields related to Civil and Environmental Engineering were present in Tampa. The number of volunteers registered at the conference was lower than expected, however, volunteers solicited through the work of the Outreach Committee members was crucial. Involvement of student groups in the planning and execution of this event raised the participation level of students the day of the Outreach Activity.

The success of this Outreach Activity has initiated multiple follow up activities that include an Outreach Activity at the 2008 EWRI Congress in Hawaii, and grant submissions between USF faculty and the Florida Aquarium. The Outreach Activity in Hawaii is being planned by the local representatives there and may be significantly different to that offered in Tampa.

Table 4: Dowell Middle School Survey Results.

	Are you able to identify the types of <u>mangroves</u> that grow in Florida?		Do you know the pros and cons of <u>storm-water</u> runoff?		Have you heard of the term <u>sustainability</u> in relation to water management?		Are you aware of what <u>civil and environmental engineers</u> do?		Do you know the purpose of <u>filtration</u> ?		Do you know how to measure water quality parameters like <u>pH, hardness and turbidity</u> ?	
Morning Survey												
	Yes	No	Yes	No	Yes	No	Yes	No	Yes	No	Yes	No
Results	13	18	14	17	11	20	7	24	27	4	10	21
Percent	42%	58%	45%	55%	35%	65%	23%	77%	87%	13%	32%	68%
Afternoon Survey												
	Yes	No	Yes	No	Yes	No	Yes	No	Yes	No	Yes	No
Results	19	8	27	0	21	6	27	0	27	0	25	2
Percent	70%	30%	100%	0%	78%	22%	100%	0%	100%	0%	93%	7%
Overall Results	There was a 28 unit increase in the percentage of participants that answered yes to the question.		There was a 55 unit increase in the percentage of participants that answered yes to the question.		There was a 43 unit increase in the percentage of participants that answered yes to the question.		There was a 77 unit increase in the percentage of participants that answered yes to the question.		There was a 15 unit increase in the percentage of participants that answered yes to the question.		There was a 61 unit increase in the percentage of participants that answered yes to the question.	

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