Floating Wetlands for the Future

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Wetland plants taken by D. O'Keefe, Michigan Sea Grant

Photo Credit: NOAA/OAR/Great Lakes Environmental Research Laboratory

Abstract

High school student volunteers at the Virginia Living Museum, inspired by the large amounts of litter they observed in their local waterways, wanted to complete a project focused on eliminating pollution and creating habitat for native wildlife. Through funding from NOAA Planet Stewards, the students learned about freshwater ecosystems, wetland habitats, and aquatic pollution while designing, building, and maintaining a floating wetland. During this project, the group worked together to build research skills, collect chemical and physical water quality data, remove pollution from the waterway, and develop an educational activity to encourage others to learn about the importance of protecting the Earth's finite freshwater resources. At the conclusion of the project, students presented the work from the project along with their educational activity to the public at multiple events focused on the environment and conservation.

Background

The Virginia Living Museum has a group of passionate homeschool and public school students who are constantly seeking to learn and be catalysts for change in their community. This group of teens observed litter flowing near the lake situated immediately adjacent to Museum grounds. After inquiring about where the litter was coming from, the teens learned it was coming in through the stormwater drains that feed into Deer Park Lake from a major road intersection and business district in Newport News, Virginia. This discovery prompted additional questions about where the water from Deer Park Lake drained and the lifecycle of the debris. Their investigation on local maps showed the water from Deer Park Lake was draining through a spillway into another local lake and then through another spillway out into the James River. Because Newport News is near the mouth of the James River, it was clear the litter they saw floating by would soon enter the Chesapeake Bay and eventually the Atlantic Ocean. This revelation led to the group's mission to prevent as much waste as possible from exiting Deer Park Lake and further polluting local waterways.

Project Development

The key goal of applying to the NOAA Planet Stewards program and starting this project was to increase scientific literacy with high school students in the Virginia Living Museum's volunteer program through a student-led project focused on environmental stewardship. Student involvement in each stage of the process from background research to project implementation was critical to each student's learning process and the final product of the project. Staff and guest professionals provided guidance and assisted in problem solving, but the overall project was led by the students.

The students began their project by researching freshwater ecosystems and the origins of marine debris. Because this group of students was only meeting once a week to work on the project due to different schooling schedules, this research process was primarily student-driven with guidance on reliable sources, modifying their queries to produce more relevant answers, and organizing their findings to share with the group. Each student researched a different topic and then shared their findings at the next meeting. While researching freshwater ecosystems, students investigated the role of wetlands in removing pollutants from aquatic environments. After reading (Chesapeake Bay Program, 2023) and (Coveney, et al., 2002), the students became concerned about the water quality of Deer Park Lake as it is small with approximately 20 sq ft of wetland habitat. The group became interested in removing litter from the waterway, and also in conducting a habitat restoration project to expand wetlands around the lake. Completing both projects was not going to be possible given the number of students and the amount of time they had together outside school hours. Further research including (Sample, 2017) and (Bi, et al., 2019) helped put a combination project into perspective: utilizing a floating wetland to increase habitat area, improve water quality, and act as a physical barrier near the spillway to prevent litter from flowing downstream.

Image 1. Students and mentors after one of the first litter cleanups on Deer Park Lake. Photo credit: Deanna Orr

Image 2. Students discuss types of native wetland plants suitable for the floating wetland with mentors. Photo credit: Deanna Orr

Implementation

Once the idea was solidified, the teens worked to create their own list of additional topics they would need to research to complete the project: how to create a floating wetland, native wetland plants and the wildlife attracted to them, and water quality parameters. They did independent work and also worked together during group meetings to finalize the details for their project. With this newly established background knowledge, they wanted to meet with experts who could provide further details. They prepared questions and had meetings with horticulturists and an environmental consultant, along with an ornithology student and an environmental science student from two local colleges.

This additional research and discussion with professionals began to put the realities of the project into focus: they likely wouldn't have the time during their once weekly meetings to construct a floating wetland of the desired size

while also collecting litter, conducting water quality testing, and creating an educational activity to share about the project. The decision to purchase a prefabricated floating island was not made lightly as it utilized over 1/3 of the project's total budget, but it was the correct call given the entire scope of the project. Two 3ft x 5ft floating islands were purchased from Floating Islands West (https://floatingislandswest.com/). While waiting for them to arrive, the students pressed forward with the other aspects of their project.

The students began conducting a variety of water quality tests each week including air temperature, water temperature, dissolved oxygen, pH, phosphate, salinity, turbidity, nitrate, nitrite, and ammonia levels. They also began weekly litter cleanups from canoes on Deer Park Lake. The litter they collected was left to dry after being collected from the lake, weighed, and then diverted into proper waste channels. The water quality testing and litter cleanups were done consistently for over 6 months.

Image 3. Students and mentors work to plant native plants into the prefabricated floating wetland. Photo credit: Alice Agnew

Image 4. Students and mentors with the floating wetland after planting was complete. Photo credit: Deanna Orr

Once the prefabricated floating islands arrived, the students and some of the professionals who had provided guidance for the project worked together to plant the selected native wetland plants. The floating wetland was then secured next to the dock instead of immediately installing it in its permanent location. This allowed easier access to water the plants multiple times throughout the week while the plants established themselves and grew roots long enough to reach the lake water under the floating wetland.

After one month of watering, monitoring, and growth, the wetland was moved to its permanent location and secured 15 feet in front

Image 5. The floating wetland was temporarily attached to the dock to allow easy access for watering and monitoring while the plants became established. Photo credit: Deanna Orr

Image 6. Students paddle back to the dock after checking on the floating wetland after it was moved to its permanent location. Photo credit: Deanna Orr

of the spillway. This placement did not impede the flow of water through the spillway, but did direct much of the litter flowing through Deer Park Lake towards the wetland where it gets caught on the leading edge of the structure.

In addition to installing the floating wetland, water quality data collection, and litter cleanups, the students also worked to create educational signage and a hands-on activity to demonstrate the importance of freshwater ecosystems.

The teens met with the Education Department at the Virginia Living Museum to learn about how to engage the public in environmental education

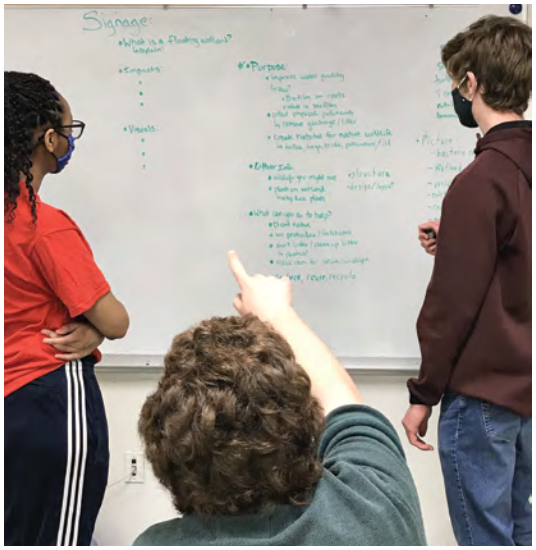

Image 7. Students work to create permanent educational signage about the floating wetland. Photo credit: Deanna Orr

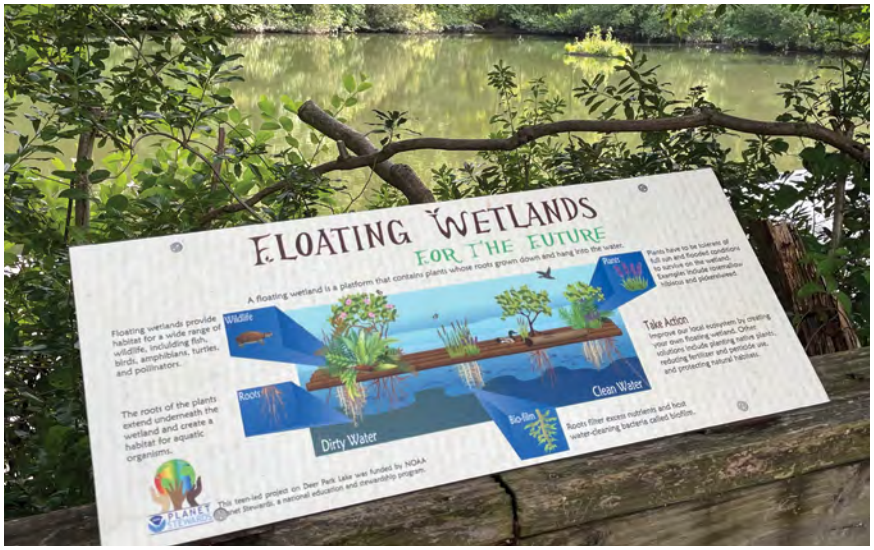

Image 8. The permanent educational signage installed in front of the floating wetland. Photo credit: Deanna Orr

Image 9. Students conduct water quality tests on the dock with the floating wetland in the background. Photo credit: Deanna Orr

and how to create a hands-on activity appropriate for a general audience. They also worked with the Exhibits Department to assist with designing and installing signage about the floating wetland.

Conclusion

Students were involved in determining each and every step of the plan, a truly student-centered project. They used many of the science practices (NGSS, 2013) as they developed research questions, used analytical thinking skills, problem-solved each challenge, learned to collect and record data, and developed an educational activity to share with the public.

Water Quality Data: After their initial idea to monitor water quality, the students realized their data would need to act as

baseline data because the floating wetland would not be installed for a large portion of the time they were collecting data. While collecting the water quality data did not result in any useful information in terms of the scope of this project, it did create a dataset to be used as reference in future projects and provided a learning opportunity for the teens. They learned to conduct water quality tests and utilize scientific tools.

Litter Collection: Collecting litter was by far the students' favorite activity. They said they liked to see the immediate impact of their work. Their goal for the project was to collect 50 lbs of litter. Their efforts resulted in 121 lbs of litter being removed from Deer Park Lake. They also took notes about the types of litter they were collecting. They most often encountered drink bottles, food packaging, and cigarette butts.

Habitat Restoration: The students set a goal of creating 30 sq ft of wetland habitat on Deer Park Lake. They accomplished this goal which more than doubled the amount of wetland habitat in the lake. They selected 12 native plant species for the floating wetland. Since being installed, a variety of birds, insects, and turtles have been observed utilizing the floating wetland. While it has not been directly observed, it is likely the variety of fish species in the lake are interacting with the root systems of the plants and utilizing the wetland.

Figure 1. Ties to the Next Generation Science Standards (NGSS, 2013)

Performance Expectation

5-ESS2-2. Describe and graph the amounts of salt water and fresh water in various reservoirs to provide evidence about the distribution of water on Earth.

Science and Engineering Practice

- Describe and graph quantities such as area and volume to address scientific questions.

Disciplinary Core Idea

- Nearly all of Earth's available water is in the ocean. Most fresh water is in glaciers or underground; only a tiny fraction is in streams, lakes, wetlands, and the atmosphere.

Cross-Cutting Concept

- Standard units are used to measure and describe physical quantities such as weight and volume.

Classroom Connections: Students measure out varying quantities of water to represent the distribution of freshwater and saltwater on Earth.

Performance Expectation

MS-ESS3-3. Apply scientific principles to design a method for monitoring and minimizing a human impact on the environment.

Science and Engineering Practice

- Apply scientific principles to design an object, tool, process or system.

Disciplinary Core Idea

- Human activities have significantly altered the biosphere, sometimes damaging or destroying natural habitats and causing the extinction of other species. But changes to Earth's environments can have different impacts (negative and positive) for different living things.

Cross-Cutting Concept

- Relationships can be classified as causal or correlational, and correlation does not necessarily imply causation.

Classroom Connections: Students will design a filter system to remove pollution from freshwater to minimize human impact on the environment.

Educational Outreach: The students worked to develop an activity (https://tinyurl.com/EARTHScientist) to demonstrate the various types of water and their respective volumes on Earth. By completing the measurements, the activity shows how freshwater sources like Deer Park Lake compare in volume to oceans, brackish water, and other sources. The second part of the activity encourages participants to "pollute" the freshwater sources with common household items and then filter the "polluted" water through a "wetland" created by different types of filters to demonstrate the role of wetlands in keeping freshwater sources clean.

The students set a goal to reach 150 people with their educational activity. They presented their hands-on activity at multiple events held at the Virginia Living Museum including Earth Day, World Ocean Day, and Clean the Bay Day. They exceeded their goal with 233 people completing the activity. Their activity was turned into a permanent educational option for interpretive volunteers and has continued to be shared with guests since the completion of the project. The students' signage is in a public exhibit area and has been

Image 10. Litter clean-ups have been continuous since the official completion of the project. Photo credit: Deanna Orr

viewed by tens of thousands of guests who have visited the Virginia Living Museum since the sign was installed.

Project Continuation

Additional volunteers have continued collecting water quality data since the completion of the student project, but no changes have been seen as of February 2023. This is likely due to the size of the wetland in comparison to the volume of Deer Park Lake and the constant runoff from local roadways.

After completing the project, the students expressed a desire for the project to continue, so recruitment began for volunteers who were interested in removing litter from the stream feeding Deer Park Lake, the lake itself, and surrounding public grounds. There are now volunteers who complete 6 clean-ups per month. From September 2021 through February 2023, these volunteers collected 1077 lbs of litter (1198 lbs total if combined with the students' 121 lbs). What was originally a passion project from a small group of teens has expanded into sustained community stewardship action.

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About the Author

Deanna Orr, Conservation and Ambassador Animal Manager at the Virginia Living Museum, has 8 years of experience in conservation, informal science education, and environmental field work. She received her Applied Global Conservation, B.S. from George Mason University. Before joining the Virginia Living Museum, Deanna built career skills with the help of mentors at organizations including the Smithsonian's National Zoological Park and Conservation Biology Institute, the Virginia Institute of Marine Science, and the Maryland Department of Natural Resources. She enjoys hiking, kayaking, relaxing at the beach, and improving her bird identification skills. Deanna can be contacted at deanna.orr@thevlm.org.

Additional support: Alice Agnew (Virginia Living Museum), Bo Baker (Virginia Living Museum), Emily Hoffman (Virginia Living Museum), Darl Fletcher (Virginia Living Museum), Meghan Garrity (Virginia Living Museum), Emmylou Kidder (Christopher Newport University), Ben Thompson (Dramby Environmental Consulting), and Katie Lee (College of William and Mary).