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INSIDE THIS ISSUE

Outer Banks, Nags Head, NC
Photo Credit Billy Skaradek

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Letter from the President

By Natalie Macke, NESTA President 2022-2024 | @NESTA_US

As the school year winds down, educator instincts kick in and I promptly begin to focus on intentions and aspirations for the next school year. Reflecting on both successes and challenges, I crave the time to evaluate and confront professional norms and consider new ways to connect with my students. The opportunity will soon arrive to permit many of us to let go of both the physical and mental day-to-day challenges that are a part of our classroom obligations. Soon the summer months will provide the time to put a spotlight on both self-care and self-evaluation. When this time is paired with administrative flexibility, creative ideas and solutions have the potential to emerge. New classroom ideas are conceived that celebrate diversity, promote equity, and continually seek to maximize the potential of all students.

The time for self-evaluation allows each of us to critically reflect on our practices and identify areas for improvement. Working on my own self-awareness, I contemplate how learning experiences should evolve in next year's classroom. Focused on scientific literacy, I welcome that teaching with "Big Ideas" and anchoring phenomena supports professional creativity and encourages students to explore their cultural competency. Through an inclusive lens, challenging traditional paradigms and examining new strategies I seek to support a diverse range of learners. This ongoing process of reflection and improvement is not only crucial for my own personal development but also for the betterment of my students' educational experiences and future success.

I invite all members to join our NESTA Private Learning Community on Facebook (https://bit.ly/3XzxZBY) this summer. Follow along, while I explore changes to my instructional goals. Remember, the best part of NESTA is the potential to realize you are part of a community of like-minded colleagues that embrace life-long learning. Take the time to access your peers and share your ideas, risks, and challenges. Let's support each other's efforts to create learning environments that support diversity, equity, and inclusion.

Committed to connecting our community;
One Earth, Our Future.

Natalie Macke

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Letter from the Guest Editor

By Bruce Moravchik, Coordinator, NOAA National Ocean Service Education

As I write this, it is already late June 2023. Last week the schools in my area finally let out for the summer, and it was truly difficult to tell who was more excited by the prospect of the break ahead – the students or the teachers. My money's on the teachers.

During the final week at my children's school, I attended their Eighth grade promotion ceremony. One of their science teachers offered inspirational words to the students, their families, and friends. During his remarks, he showed a video made to Carl Sagan's famous speech "The Pale Blue Dot" (https://www.youtube.com/watch?v=EWPFmdAWRZ0). If you're not familiar, "The Pale Blue Dot" is a photograph of Earth taken in 1990 by the Voyager 1 space probe from about 4 billion miles from Earth. Through his brief but moving words, Carl Sagan reflected on the fragility of Earth, our one and only home, and its our place in the universe. He talked about the human condition, how unkind we often behave toward one another, and how we must strive to do better. I am deeply moved every time I see it.

As I watched the video, I thought about all the educators I am so fortunate to support through NOAA Planet Stewards who work tirelessly to actualize the message of "The Pale Blue Dot" by strengthening their own environmental knowledge and stewardship ethic, and imparting it to their students and communities through education and hands-on stewardship.

In the following pages you'll read a few examples of amazing educators and students supported by NOAA Planet Stewards. They have returned to their classrooms after the pandemic to restore and expand native habitats, reduce marine debris, and address a myriad of environmental impacts affecting their local communities and the world. They are making a difference.

During just the past year, these projects collectively made impressive progress. More than I6,650 students, educators, partners, and families engaged in 84,377 hours learning the science related to their stewardship projects and carrying out stewardship activities. They removed more than 840 pounds of marine debris from beaches and wetlands, as well as 262 pounds of invasive zebra mussels, common carp, and quagga mussels, and 701 square feet of invasive plant biomass. They planted 1,712 native trees and shrubs, and restored more than five acres of land. Their work has led to a calculated reduction of more than 7.5 tons of atmospheric carbon dioxide just one year after planting.

I hope that as you read this issue, you will be inspired to expand your students' or communities' knowledge and stewardship ethic, encourage them to make a difference, and effect real change in our world, on our pale blue dot, here and now.

Be sure to subscribe to the NOAA Planet Stewards Newsletter: The Watch https://oceanservice.noaa.gov/education/planet-stewards/the-watch-archive.html and discover new and exciting opportunities for you and your students through NOAA and our partners.

Bruce Moravchik

Coordinator, NOAA National Ocean Service Education (https://oceanservice.noaa.gov/education/)

Manager, NOAA Planet Stewards (https://oceanservice.noaa.gov/education/planet-stewards/)

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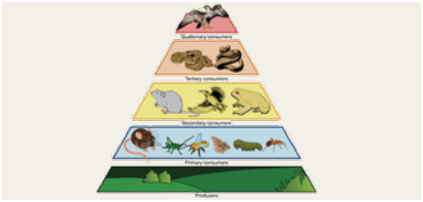
Join the NOAA Planet Stewards 2023-2024 Book Club!
https://oceanservice.noaa.gov/education/planet-stewards/upcoming.html#bookclub.

Modeling Marine Ecosystems with Virtual Reality

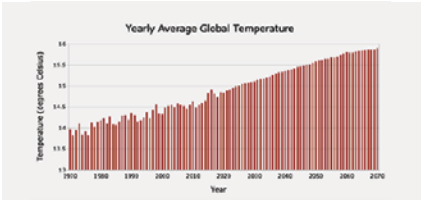
Modeling Marine Ecosystems with Virtual Reality is made up of three NGSS aligned modules in which high school students explore how scientific models work. Students use the same scientific data and models used by NOAA scientists to explore human-caused changes in ocean ecosystems and the impacts these changes have on the animals in those ecosystems. All modules include student worksheets, NGSS alignment, and presentation graphics.

The modules feature the Virtual Ecosystem Viewer, an interactive virtual reality model that NOAA scientists use to visualize changing ocean ecosystems.



Ocean Food Webs

Students use the concepts of food webs and trophic levels to explore populations of marine organisms. They research an organism and combine their data in a jigsaw activity to produce a food web diagram for that habitat. Students then collect biomass data during "virtual dives" to determine the relationship between biomass and trophic levels.



Observations and Models

Students learn about data derived from observations and data produced by models, including how to recognize each, and how each type is used to make predictions. Students also explore methods to estimate the size and composition of populations. Students then observe simulated marine habitats generated by models and observational data to estimate future populations of tuna and of lobster.

Predators and Prey

Students are introduced to models used to predict populations of organisms. Students first analyze a simple predator-prey system, optionally building and "running" a simple, spreadsheet-based model. They compare population graphs produced by the model with historical data from a similar, simple predator-prey system. Students then collect data in simulated marine habitats, gathering biomass data for predators and their prey in complex marine food webs, comparing changes over time to the dynamics in simpler systems with a single predator and its lone prey.

LEARN MORE HERE

Join the 2023-2024 Book Club with books of thought-provoking topics to be discussed at monthly meetings.

PLANET STEWARDS

SCHEDULE

Sep 12, 2023	Don't Look Up
Oct 10, 2023	Diary of a Young Naturalist
Nov 14, 2023	There's Something in the Water: Environmental Racism in Indigenous and Black Communities
Dec 12, 2023	Escape Undersea
Jan 9, 2024	Fragment, a climate crisis novel
Feb 13, 2024	Engage, Connect, and Protect: Empowering Diverse Youth as Environmental Leaders
Mar 12, 2024	The Only Woman in the Room: Why Science is Still a Boys' Club
Apr 9, 2024	Consumed: The Need for Collective Change: Colonialism, Climate Change, and Consumerism
May 14, 2024	Fen, Bog & Swamp

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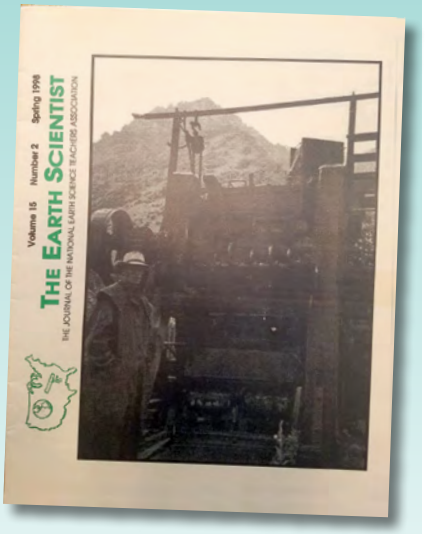
25 Years Ago in TES



Twenty-Five years ago, in 1998, TES was in its fifteenth year of publication. The focus of the 1998 Spring issue was Minerology. The front cover is a photo showing a guide at an old stamp mill at the Otago Gold Field's historic panning site in Queenstown, New Zealand. This stamp mill still operates. The Spring issue led off with a four-page summary of the 1998 debate as to how to best use Utah's remote Grand Staircase area, which is an area of over one million pristine acres of beauty with tremendous coal, oil and gas potential. This was followed by a five-page summary of the importance of the Crushed Stone Industry. Next was an eight-page article about importance of the Coal Industry, followed by a four-page article about the Colors of Minerals. The final pages included Media Reviews about Virtual Communities of Scholars and a discussion of Mining in Missouri.

By Tom Ervin

NOAA PLANET STEWARDS

oceanservice.noaa.gov/education/planet-stewards

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Patty Schuster, Page Designs

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Advocates for Change

Amy Durham Shea, Environmental Learning Center, Vero Beach, Florida

Debris along the eastern shoreline of Eastern Island before a 2016 marine debris removal mission.

Photo Credit: NOAA PIFSC Coral Reef Ecosystem Program

Abstract

Every day, people use and discard single-use plastic items, many of which make their way to coastal areas as marine debris. As the population of Vero Beach, Florida continues to grow, so does our community's potential to use and discard single-use plastics unless something is done to inspire our members of our community to switch to more sustainable options. Through this project, funded by the NOAA Planet Stewards, middle and high school youth volunteers at the Environmental Learning Center in Vero Beach collected over 200 pounds of marine debris from local waterways. A large portion of this debris was plastics in various sizes and forms, ranging from plastic forks, beach toys, and candy wrappers to tiny, unidentifiable fragments. After collecting and analyzing the debris, the youth were given the platform to educate others about the causes and impact of marine debris and single-use plastics. They created an advocacy video for younger students and an artful, interactive display that incorporated all of the plastic they collected during their beach clean-ups. Together, these two advocacy pieces show the impact that youth can have in addressing environmental issues through direct stewardship action and by using their unique perspective to educate and inspire others to take action in our local community.

Introduction

The Environmental Learning Center (ELC) is a nature center located on an island in a coastal estuary in Vero Beach, Florida. Like many Florida towns, Vero Beach is a growing metropolis. Thousands of new residents move to the area each year and are joined by an even larger number of tourists looking to spend their holidays somewhere warm and sunny. Every day, visitors and residents alike use plastic straws, cutlery, bags, and to-go containers, which are often used only one time before being discarded. Plastics, both large and microscopic, are one of the largest components of the growing amount of marine debris found in our oceans and Great Lakes (Wessel et al., 2019, NOAA, 2023). A five-year study in Florida showed that the most common types of plastic marine debris included single-use plastic items, such as straws, plastic bottles, and plastic bags (NOAA, 2017). The impacts of marine debris include damage to habitats, ingestion by and death of marine life,

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navigational issues, risks to human health, and even economic losses due to decreases in tourism (NOAA, 2017). As the number of people living in and visiting the Vero Beach area continues to grow, so will the use of plastics; unless we decide to make a change.

The ELC seeks to inspire and empower all people to be active stewards of the environment. This mission means engaging people in stewardship activities, as well as helping them to see themselves as people who can make a meaningful difference in the world and inspire others to do the same. With this project, generously funded by NOAA Planet Stewards, our goals were:

- actively engage youth in stewardship action to remove marine debris from local waterways.
- increase their knowledge about marine debris and single-use plastics and their impact on the environment.
- empower youth to educate others through a youth-directed advocacy project.

The First Steps

Before we could give our students the platform to educate others, we wanted them to see first-hand the impact of debris in marine environments. We rallied our Green Teen! high school volunteers to plan and execute a series of beach clean-ups at one of the area's publicly accessible beaches. However, the impacts of COVID-19 meant that we quickly had to alter our approach to this project. As a result of the pandemic, we had a much smaller number of high school volunteers than anticipated, so we refocused our efforts to also engage members of our middle school-aged environmental club. Our Junior Interpreters, as we call these dedicated middle school students, along with several community groups and professionals working in environmental fields, surpassed our expectations over a series of four coastal clean-ups, collecting double our targeted amount of 100 pounds of marine debris.

In tandem with these clean-ups, we wanted to provide opportunities for the youth to understand the impact of marine debris on marine environments. At each clean-up, students sorted and logged the debris they collected in the Marine Debris Tracker app (https://marinedebris.noaa.gov/partnerships/marine-debris-tracker) or (https://debristracker.org) allowing them to contribute to a larger database and understand how prevalent plastic debris in particular is in marine environments. Through this process, they began to understand that plastic does not just disappear but instead degrades into smaller and smaller pieces. As they spent time sorting and counting increasingly miniscule plastic remains, they quickly identified this topic as a key area to address for their future advocacy campaign. Back at the ELC, we provided the youth with supporting opportunities to learn more about the impacts of marine debris and plastic pollution. They researched the impacts of plastic and how plastics break down in the environment. They also had the opportunity to dissect albatross boluses filled with plastic marine debris to understand how debris can reach animals and habitats across the globe.

Advocating for Change

Empowered with knowledge and first-hand experience, we then asked these youth to take the lead in educating ELC visitors. We had previously identified the need for an exhibit in the visitor center and a way to engage our on-campus program attendees about plastic use. We aimed to balance these identified interpretive goals with the desire for the advocacy pieces to be student-led and saw these projects as an opportunity to provide youth with an audience and platform to allow their voices and perspectives to be shared. Rather than beginning with

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a preset curriculum, we provided supporting lessons as needed. These lessons ranged from learning the basics of environmental interpretation and exhibit design to video editing and how to use simple power tools.

Related Lesson Plan: https://docs.google.com/document/d/1Nx3weUmb5VYHJbDwIFAW4C9mOpK9BwD1INXDjpbmnOU/edit?usp=sharing

Image 1. Student shares small plastic pieces found during the beach clean-up.

Photo credit: Heather Kramer

Image 2. Student sorts the garbage found into categories to enter into the NOAA Marine Debris Tracker App.

Photo credit: Heather Kramer

Over several months, students carefully cleaned and separated the plastic debris they found on the beach, sketched and refined exhibit designs, and wrote and revised interpretive scripts.

The first advocacy piece they created was a video aimed at encouraging younger students to reduce the amount of single-use plastics they brought to on-campus events in their lunch boxes. The video featured a single-use plastic trash monster who is "trying to take over the world." The trash monster is at the ELC attempting to spread plastic pollution. It highlights the various single-use plastics that younger students may bring in their lunch boxes to on-campus programs and provides suggestions for reusable alternatives helpful in the effort to "defeat single-use plastic trash monsters."

The second advocacy project was an artful, interactive exhibit in the ELC's visitor center. This display piece incorporated all of the plastic debris collected during the beach clean-ups arranged as a giant wave of garbage that feels as though it may crash down over you.

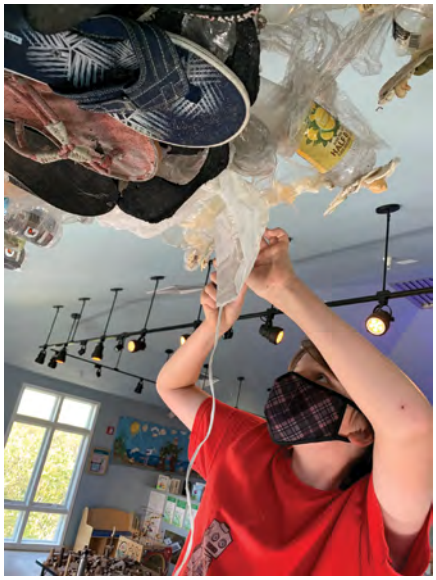

Image 3. Student adds marine debris collected during beach clean-ups to the "Wave of Garbage" interpretive exhibit.

Photo credit: Heather Kramer

Images 4 and 5. "Wave of Garbage" interpretive, interactive exhibit on display at the ELC's visitor center.

Photo credit: Amy Durham Shea

Since these students were struck by the particular prevalence of small fragments of plastics left behind as larger plastic items broke down in the sun and surf, their display included an interactive element that allows guests to sift through sand to see the small pieces of plastics hidden within. Accompanying interpretive signs focused on educating guests about marine debris and its sources and what happens to single-use plastics after their single use, as well as encouraging them to reduce their use of single-use plastics and take steps to reduce marine debris.

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Results

Through this project, 57 youth were engaged in 375 hours of stewardship activities. They completed 4 clean-up activities and logged just over 223 pounds of marine debris in the Marine Debris Tracker app. The logged debris included thousands of individual pieces. In the first clean-up alone, students, volunteers, community mentors, and ELC staff members collected 1,343 individual pieces of debris, including 375 hard plastic pieces, 366 food wrappers, and 235 pieces of foam. In addition, pre- and post-assessments showed an increase of student knowledge about marine debris following the beach clean-ups and supporting learning opportunities, as shown in Figure 1. On the pre-assessment, students scored as an average of 69% compared to an average of 75% on the post-assessment.

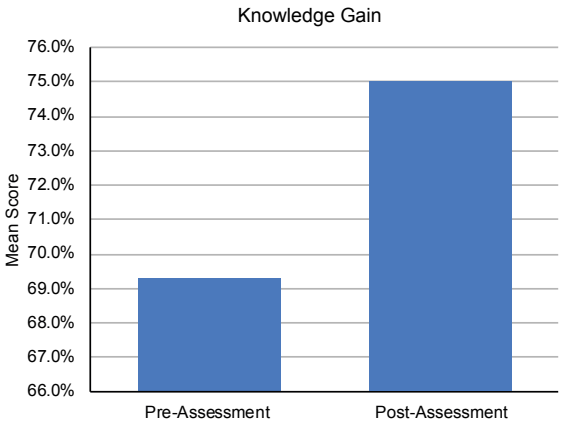

Figure 1. Results of pre- and post-assessments to measure knowledge gain about marine debris and its impact on the environment.

ELC staff distributed the youth-created advocacy video to future program participants via email, asking participants and their parents or guardians to watch the advocacy video prior to coming to their on-campus program. ELC Youth Created Advocacy Video: https://www.youtube.com/watch?v=Qk64Fdhs74I

Staff, youth volunteers, and interns measured the amount of single-use plastics that program participants brought to on-campus programs both before and after the distribution of the advocacy video by collecting and weighing all single-use plastics used during meals by program participants. This included plastic cutlery, plastic bags, bottles, and food wrappers. As seen in Figure 2, program participants without an opportunity to view the advocacy video brought significantly more single-use plastics (Mean score = 0.09 pounds per person, SD = 0.07, n = 137) than those participants who had the opportunity to view the advocacy video prior to their scheduled program (Mean score = 0.06 pounds per person, Standard Deviation = 0.06, n = 140) ($p < 0.01$). It is, however, important to note that the ELC was unable to track or verify that program participants watched the video after it was made available, and additional factors, such as program participant demographics or frequency of participation in ELC programs, may have had an effect on single-use plastic use. Despite these factors, the results remain encouraging in showing the potential impact of youth-led advocacy for a local and global environmental issue.

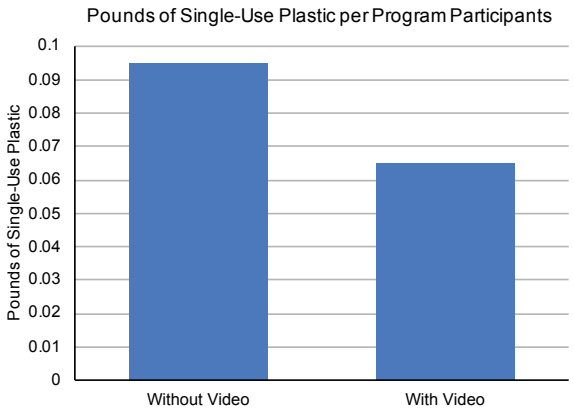

Figure 2. Amount of single-use plastics brought to on-campus programs by program participants without the opportunity to view and with the opportunity to view the advocacy video.

Due to visitor limitations caused by COVID-19, there was limited opportunity to assess the impact of the visitor center exhibit. A visitor survey was implemented both before and after the installation of the exhibit in order to measure impact on visitors' knowledge of marine debris, beliefs about the importance of marine debris, and stated likelihood of taking actions to reduce marine debris. Visitors who completed the post-assessment after the installation of the exhibit scored an average score of 81% (n = 9) on the knowledge assessment portion compared to an average score of 63% (n = 6) by visitors who completed the pre-assessment prior to the installation of the exhibit. The majority of this increase in score can be attributed to an increased understanding of the sources of marine debris and ways to prevent marine debris. When asked to rank on a 5-point Likert scale how important of an issue they believe marine debris is and if their experience at the ELC increased that

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likelihood of taking action to help address marine between, visitors who completed the post-assessment rated the importance of marine debris and their likelihood of taking action only slightly higher (Mean score = 4.90, n = 9 for both questions) than those visitors who completed the pre-assessment (Mean score = 4.67, n = 6 for both questions). Due to the small sample size, we were not able to determine if the exhibit had a significant impact on beliefs about the importance of marine debris or stated likelihood of taking action. However, the exhibit is undoubtedly a powerful reflection of these youths' experiences, and its creation provided them the opportunity to leave a lasting legacy of their work with the potential to educate thousands of annual visitors in the coming years.

Conclusion

In total, 57 middle and high school students spent 375 hours learning about and taking a stand against the growing problem of marine debris in our environment. They surpassed the amount of marine debris expected to be collected through this project, while carefully sorting each piece to contribute to a growing database tracking global marine debris. Beyond the direct impact of removing debris from local beaches, these youths used their collective voices to advocate for a more sustainable future. Supported with appropriate learning opportunities to create advocacy pieces that reflected their experiences and understanding of marine debris, these students demonstrated the impact a small group of dedicated youth can do to inspire the switch and make a larger impact on for their community and the environment.

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About the Author

Amy Durham Shea became a Planet Steward in 2020 while working as an environmental educator at the Environmental Learning Center in Vero Beach, FL. She has an undergraduate degree in psychology from the University of Arkansas, a master's degree in education from Vanderbilt University, and professional certificates in free-choice learning and fisheries management from Oregon State University. She is a Certified Interpretive Guide and Certified Interpretive Trainer through the National Association of Interpretation and a member of the National Network of Ocean and Climate Change Interpretation. She has worked in a variety of formal and informal educational settings since she relocated to Florida from Arkansas over twelve years ago. She enjoys educating people of all ages about fisheries, climate change, marine and estuarine ecosystems, and local Florida habitats through place-based experiences and has a strong interest in understanding how different messaging approaches impact people's perceptions of environmental issues. Amy currently works as a Curator of Education Programs at Brevard Zoo in Melbourne, FL and can be reached at akdurham@gmail.com.

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Floating Wetlands for the Future

Deanna Orr, Virginia Living Museum, Newport News, Virginia

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.

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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

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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

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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

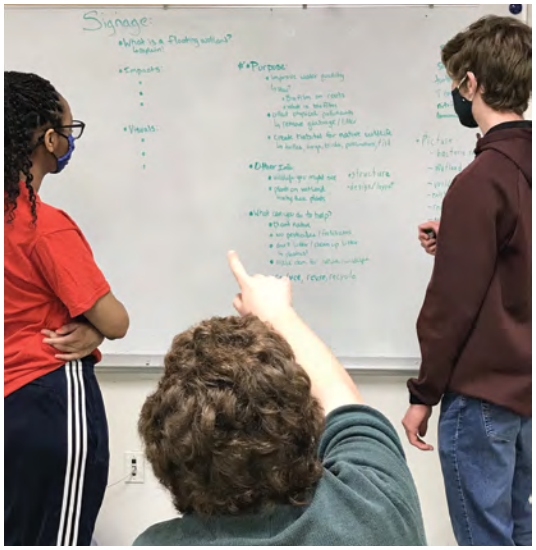

Image 7. Students work to create permanent educational signage about the floating wetland. Photo credit: Deanna Orr

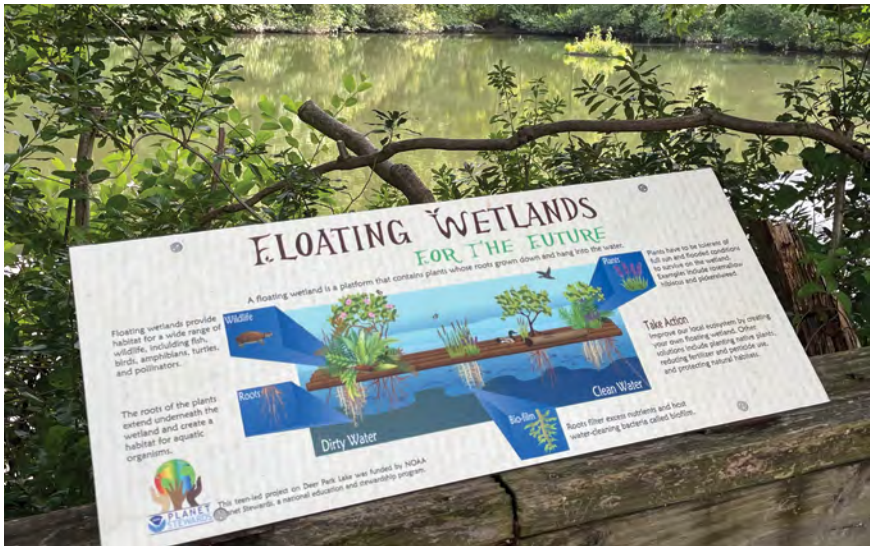

Image 8. The permanent educational signage installed in front of the floating wetland. Photo credit: Deanna Orr

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

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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

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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.

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Clean Up Crew: Empowering Future Changemakers

Kelley Hodges, Patronis Elementary School and an Adjunct Professor of Science Education at Florida State University-Panama City Beach Florida

The walls of the Patronis Elementary School media center were transformed to showcase the importance of our waterways, marine animals, and marine ecosystems.

Photo Credit: Kelley Hodges

Abstract

"Clean Up Crew: Empowering Future Changemakers" is a NOAA Planet Stewards project designed to educate, inspire, and motivate students about marine debris mitigation in the K-5 public school setting. This was a year-long project integrating marine debris education, stewardship, and outreach with Next Generation Science Standards (NGSS, 2013). Students embarked on a journey to understand and learn how marine debris impacts our coastal community, school, and homes. Together, we removed 327 pounds of trash from area beaches, completed more than 800 acts of environmental stewardship, and shared our learning with our community through outreach and art. Students applied STEM principles throughout the project to address marine debris through personal and civic action to improve our world.

Introduction

"People protect what they love...." –Jacques Cousteau. For young children, their world includes home, school, the backyard, and the playground. At this stage, it is essential to foster empathy and encourage exploration of their environment. Our backyard and playgrounds are the Gulf of Mexico and the surrounding waterways. Our students need learning experiences that reach beyond the classroom, allowing them to learn about local biodiversity and develop a lifelong love and understanding of the surrounding environment. Encouraging young learners to develop a deep love for the wildlife and ecosystems surrounding them will empower them to make choices that protect and preserve our precious resources.

Clean Up Crew: Empowering Future Changemakers is a NOAA Planet Stewards project designed to educate young learners about marine debris and its impact on beaches and marine life. As coastal community residents, we witness the impact of derelict fishing gear, single-use plastics, and abandoned recreational equipment on our beaches and waterways. It is common to see sand toys, water bottles, beach chairs, and tents left on the beach after a busy summer weekend. This debris damages our sensitive coastal and marine ecosystems, from the smallest microscopic organisms to larger animals like sharks, whales, and sea turtles (NOAA, 2021). The pressure placed on our sensitive marine ecosystems is immense,

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Table 1. Possible connections to the Next Generation Science Standards (NGSS Lead States, 2013)

Performance Expectations

2-PS1-1 Matter and Its Interactions: Plan and conduct an investigation to describe and classify kinds of materials by their observable properties.

K-ESS3-3. Earth and Human Activity: Communicate solutions that will reduce the impact of humans on the land, water, air, and/or other living things in the local environment.

5-ESS3-1 Earth and Human Activity: Obtain and combine information about ways individual communities use science ideas to protect the Earth's resources and environment.

Science and Engineering Practice

- Planning and Carrying Out Investigations
- Analyzing and Interpreting Data
- Constructing Explanations and Designing Solutions

Disciplinary Core Idea

- ESS3.C: Human Impacts on Earth Systems: Things that people do to live comfortably can affect the world around them.
- ETS1.A: Defining and Delimiting an Engineering Problem: Asking questions, making observations, and gathering information are helpful in thinking about problems.
- ETS1.B: Developing Possible Solutions: Designs can be conveyed through sketches, drawings, or physical models.
- ESS3.C: Human Impacts on Earth Systems: Human activities in agriculture, industry, and everyday life have had major effects on the land, vegetation, streams, ocean, air, and even outer space.

Cross-Cutting Concept

- Patterns: Patterns in the natural and human designed world can be observed.
- Cause and Effect: Events have causes that generate observable patterns.
- Energy and Matter: Objects may break into smaller pieces and be put together into larger pieces, or change shapes.

Overview of Grade Level Plans for Each Nine Week Period			
First Quarter (August 10- October 8)			
	3rd Grade	**4th Grade**	**5th Grade**
Major Themes	Nature of Science	Nature of Science	Nature of Science
Stewardship	Beach Clean Up & Sea Turtle	Beach Clean Up & Sea Turtle	Beach Clean Up & Sea Turtle
Data Collection	Count/Sort Marine Debris	Count/Sort Marine Debris	Count/Sort Marine Debris
Outreach Activities	Share with school & social media	Share with school & social media	Share with school & social media
STEM Career Activities	Nancy Evou-NOAA	Nancy Evou-NOAA	Nancy Evou-NOAA
Second Quarter (October 11 - December 22)			
	3rd Grade	**4th Grade**	**5th Grade**
Major Themes	Energy & Transformations	Earth's Features/FL Resources	Climate & Weather
Stewardship	Reduce, Reuse & Recycle	Reduce, Reuse & Recycle	Reduce, Reuse & Recycle
Data Collection	Cafeteria Plastic	Cafeteria Plastic	Cafeteria Plastic
Outreach Activities	Marine Debris Masks	Marine Debris Masks	Marine Debris Masks
STEM Career Activities	GWMI-Virtual	GWMI-Virtual	GWMI-Virtual
Third Quarter (January 7 - March 11)			
	3rd Grade	**4th Grade**	**5th Grade**
Major Themes	Plants	Life Cycles	Comparative Anatomy
Stewardship	Civic Action	Civic Action	Civic Action
Data Collection	Marine Debris Data Tracker	Marine Debris Data Tracker	Marine Debris Data Tracker
Outreach Activities	Art Contest	Art Contest	Art Contest
STEM Career Activities	NSA-PC Field Trip	NSA-PC Field Trip	NSA-PC Field Trip
Fourth Quarter (March 14- May 25)			
	3rd Grade	**4th Grade**	**5th Grade**
Major Themes	Adaptations	Adaptations & Food Chains	Adaptations
Stewardship	Earth Week Challenge (Choice Bo	Earth Week Challenge	Earth Week Challenge
Data Collection	Choice Boards & Trash Removal	Choice Boards & Trash Removal	Choice Boards & Trash Removal
Outreach Activities	Marine Debris Art on Trash Cans	Marine Debris Art on Trash Cans	Marine Debris Art on Trash Cans
STEM Career Activities	Michelle Duncan @ NOAA	Michelle Duncan @ NOAA	Michelle Duncan @ NOAA

Figure 1. Project Timeline and Stewardship Activities

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and it is time to create meaningful educational and stewardship opportunities for our young learners and future changemakers.

The Process

This project integrated marine debris education, stewardship, and outreach with Next Generation Science Standards (NGSS, 2013).

Education is the most crucial step in marine debris mitigation and a critical part of the project's long-term and lasting success. (Zeh, 2021). Broad goals in designing the project included guiding learners to become aware of marine debris in their community, within their schools and homes, and engaging learners in meaningful stewardship to reduce marine debris through personal action and community outreach.

We started by outlining a year-long educational plan and identifying the project's stakeholders. They included our school administration, classroom educators, community partners, and local organizations. A quarterly plan was established and shared with the stakeholders (see Figure 1), and tentative dates were set prior to the school year.

Project Outcomes

- Mobilize elementary students to engage in environmental stewardship activities connected to removing and eliminating marine debris in our school and community.
- Remove 300 pounds of trash from area beaches and our school campus
- Inventory plastic generated in the school cafeteria over a week and use it to create trash art.
- Implement NGSS-aligned science lessons to educate students about marine debris.
- Engage our students in outreach activities that allow them to share their learning and stewardship with our local community.

Implementation

Looking Out: Trash and Debris on Our Beaches

Our school is just miles from the Gulf of Mexico, and interconnected waterways surround our community. Sea turtles and shorebirds nest on our beaches, and marine life include dolphins, manatees, sharks, and fish. Our community has local organizations dedicated to conservation and education. We partnered with a local non-profit, "Keep PCB Beautiful," to offer beach cleanups on three Saturday mornings between August and October.

Our school families removed 327 pounds of trash from area beaches. We collected the trash and displayed it at school for all students to see. They marveled at the things people leave behind (hats, sunglasses, and shoes) and wrinkled their noses at other trash items (cigarette butts, straws, and food wrappers). The trash was cleaned, sorted, measured, and weighed in the STEAM Lab and integrated with NGSS-aligned science lessons.

In addition to the beach cleanups, we adopted sea turtle nests through a local NOAA affiliate, Panama City Beach Turtle Watch (PCB Turtle Watch). Volunteers from PCB Turtle Watch allowed students and families to attend nest excavations. At the excavations, we counted the eggs, observed hatchlings, and learned from biologists about the nesting habits of sea turtles.

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Image 1. Marine debris from beach clean-ups is placed on a tarp outside of the STEAM Lab. The marine debris in this photo was used in the STEAM Lab for students to sort, measure, and weigh. Photo Credit: Kelley Hodges

Image 2. Students are using marine debris to learn about the properties of matter.
Photo Credit: Kelley Hodges

Image 3. Students are participating in a mock turtle stranding. In this photo, they are working alongside a scientist to measure, weigh, and observe a stranded turtle. Together they moved the turtle to a safe location for medical help.
Photo Credit: Kelley Hodges

Continuing our learning about sea turtles, we invited Gulf World Marine Institute to our school to share with students their work to rescue and rehabilitate stranded marine animals. Students participated in a mock turtle stranding and viewed artifacts like the jawbone of a sperm whale. All of our community partners helped students make connections between marine species and the impact of marine debris on animals and ecosystems.

Looking In: Reduce, Reuse, and Recycle at School and at Home

Opportunities for students to investigate and observe marine debris at school and at home started with collecting single-use plastic used in our school cafeteria. 100% of our students receive free and reduced lunch. We focused our collection and observations on plastic generated from the cafeteria and remained mindful that many students have little control over how their food is prepared or served. Student teams outfitted with gloves and a bucket collected plastic at the end of lunch. They collected sandwich bags, straws, lids, trays, utensils, and bowls. The plastic was cleaned and sorted, and displayed in the STEAM (Science, Technology, Engineering, Arts and Mathematics) Lab. With each grade level, we discussed the types of plastic and the amount of plastic waste generated in a week and over a year. We created a list of actions students can take to reduce plastic waste, and we created

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recommendations to reduce plastic in our cafeteria. Student observations included plastic utensils and Styrofoam trays used only once. Students created a list of recommendations for our cafeteria provider and wrote more than one hundred letters with specific examples to reduce single-use plastic in our cafeteria. We invited a representative from the food service company to visit with our students and listen to their concerns about single-use plastic in our cafeteria. The visit taught us that the Styrofoam trays and plastic-wrapped utensils were due to COVID guidelines. Many reusable items, like lunch trays and utensils, were stored away for the time being. While we were not successful in reducing plastic in our cafeteria, our students learned they could question our cafeteria providers and seek change through positive communication.

Taking Action: What Can We Do?

Stewardship is the careful and responsible management of something entrusted to one's care. Our goal included guiding students to learn that they can make a difference in the world in which they live. An essential element is encouraging them to make personal choices at school and home to reduce single-use plastic and marine debris. Two stewardship challenges were offered to the entire school, one in the fall and one in the spring. A choice board with nine stewardship activities was sent home with students. The choice board included a parent letter explaining the goals for the challenge. Challenges included bringing a litterless lunch, a reusable water bottle, and picking up trash at school or in their

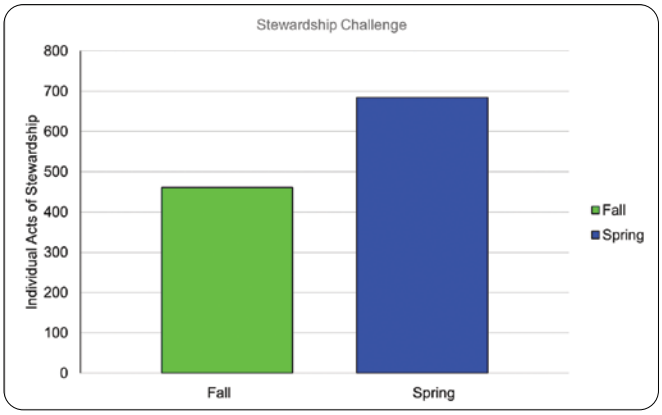

Figure 2. We collected data on the number of stewardship activities completed through the stewardship challenges.

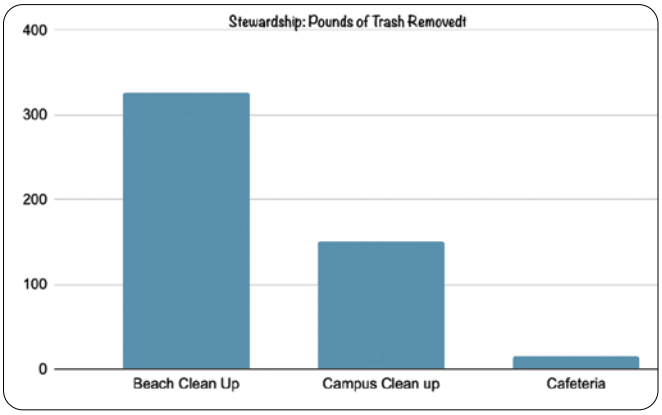

Figure 3. Pounds of debris removed during clean-up activities.

neighborhood. Altogether, the choice board had nine challenges. We collected data on the number of challenges completed in the fall and compared the data with those completed in the spring.

Students' excitement and desire to engage in environmental stewardship throughout the school year blossomed. By November, students formed clubs and used recess time to pick up trash in our schoolyard. Data collected from student-driven stewardship included participation in campus cleanups and weighing and sorting the amount of marine debris collected from beach and campus cleanups.

Outreach

Art is a powerful way to communicate, educate, and inform. In this project, we used art to communicate and share the stewardship activities completed by our students. Students

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Image 4, 5, 6. A local fishing rodeo showcased our 3rd-grade trash art. 100 students' art pieces were displayed at the art show, along with posters communicating the purpose of the art and the stewardship activity of removing marine debris from area beaches. Photo Credit: Kelley Hodges

created trash art and participated in a school-wide marine debris art contest. Our art teacher, Jessica Hughson, found inspiration in the Washed Ashore curriculum and guided students to create art from marine debris collected during beach cleanups.

Artwork included a sea turtle made from buckets and shovels, a crab made from spoons, birds made from cups and straws. The artwork caused people to stop and think and wonder. It also provided an educational opportunity for our community to learn about the impact of marine debris. The art contest allowed students to share their learning about marine debris in a creative format. The art contest was a school-wide event; we received more than 55 submissions. Students drew pictures of sea turtles surrounded by fishing nets, plastic bottles, and spoons floating in an ocean filled with wildlife. They chose messages like "Save Our Beaches" and "Be a Part of the Solution...Not

Image 7. 87 students submitted artwork for the marine debris art contest. The artwork was displayed in the STEAM Lab before the winning artwork was chosen. This image shows the artwork displayed in the classroom. Photo Credit: Kelley Hodges

Image 8. The trash cans created from the marine debris art contest are stacked in front of our school.
Photo Credit: Kelley Hodges

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the Pollution" to accompany their artwork. We sent the images from the winning artwork to a local company that transferred the images to vinyl and wrapped trash cans with them. The trash cans now line our school and continue to inform and educate visitors, students, and staff about the impact of marine debris on our ecosystems.

Results

Stewardship:

- 120 members from our school (parents and children) removed 327 pounds of marine debris from area beaches.
- 90 students completed 357 acts of stewardship in the fall and 105 students completed more than 490 acts of environmental stewardship in the spring.
- Outreach: 300 pieces of trash art were created by our third, fourth, and fifth-grade students.

Conclusion

We experienced a few challenges with the implementation of this project. Each challenge required communication, flexibility, and creativity to accomplish the vision of the project. Ongoing COVID restrictions limited off-campus field trips. This required us to coordinate with community organizations and offer events in alternative formats. We invited the experts to our school and embedded learning within the normal school day. We experienced additional unintended positive results as students felt empowered and energized to engage in stewardship. We had groups of students form environmental clubs and they used recess to pick up trash around the school campus. We also had a wonderful response from parents and our community supporting our efforts to encourage environmental stewardship.

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About the Author

Kelley Hodges is a Science Intervention Teacher at Patronis Elementary School and an Adjunct Professor of Science Education at Florida State University-Panama City. She lives in Panama City Beach, Florida, and is in her 20th year of teaching. Her career in education includes teaching college, high school, middle school, and elementary school science and mathematics. Her current role at Patronis Elementary School includes hands-on inquiry-based science instruction for students in grades 3, 4, and 5 and science instructional support and guidance for all classroom teachers. Since joining Patronis Elementary School, she has secured funding to support science instruction and environmental education and developed a schoolwide environmental stewardship program focused on marine debris and its impact on marine ecosystems. She established a multi-age First LEGO League robotics program at Patronis supporting efforts to bring coding, robotics, fun, and core values to young learners. Her work in the community includes curriculum development and teacher training for STEM in a Box, a joint effort between Florida State University and the Navy Lab-Panama City. Kelley earned a Bachelor's degree in Animal Physiology and Neuroscience from the University of California, San Diego and a Master's Degree in Science Education from Florida State University. Kelley can be reached at hodgekc@bay.k12.fl.us or khodges1993@comcast.net.

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Beaumont Rain and Butterfly Garden

Patrick Goff and Kyla Trahan, Beaumont Middle School, Lexington, Kentucky

Photo Credit: Pennsylvania Department of Conservation and Natural Resources

Abstract

Beaumont Middle School (BMS) wanted to increase the capacity of the current rain garden to better handle the stormwater runoff that was coming from the main section of the parking lot. By increasing the size of the rain garden system through funding from the NOAA Planet Stewards, we were able to increase the capacity to catch, mitigate and filter stormwater runoff from a large impermeable surface, the main section of a parking lot. This project gave students the opportunity to investigate science in a real-world setting.

Introduction

Beaumont Middle School is located in a suburban landscape near the headwaters of the Wolf Run Watershed that does not have well-designed storm water mitigation plans. The school campus is located with a large roofed building (the school) and a large paved parking lot for the faculty and visitors. Currently, BMS has two rain gardens that were built but are not adequate to handle the volume of water that sheds off these two structures. Habitat conservation and restoration was the main focus of this project funded by the NOAA Planet Stewards. By helping mitigate the runoff at Beaumont Middle School, the project is helping Wolf Run become a healthier/stronger stream allowing for a better watershed system. A secondary goal was to build a butterfly garden to help build a habitat for local and migrating butterflies and bees. (Nature Conservancy, 2019)

Project Implementation

The teachers involved in this project had worked previously to install two rain gardens. This has created a new habitat for local wildlife on the school property, apartment complex and other houses in the local community. The established rain gardens are home to various squirrels, rabbits, robins, starlings, sparrows and a multitude of other animals. While working on those rain gardens, it became apparent that the current system was not large enough to adequately handle the runoff from the impermeable parking lots in order to process and filter more stormwater runoff. Another rain garden was needed. (Scubberly, 2021)

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Partners in the project included Kyla Trahan and Patrick Goff, BMS teacher representatives, Bruce Hutcheson, President of Friends of Wolf Run, and Nachie Braga, owner of Geomancer Permaculture. Mr. Hutcheson was the community liaison and expert on the local watershed. Nachie was the rain garden expert to help with site selection, plant selection, design and install of the rain gardens. Eight students were actively involved in the project.

Image 7. Bruce Hutcheson, President of Friends of Wolf Run, comes in to talk with our rain garden club about the importance of the rain garden on the Wolf Run watershed. Photo credit: Patrick Goff

Image 8. Nachi, helping explain why our students would want to use native plants in the rain garden system. Photo credit: Patrick Goff

The existing rain gardens, when measured, came to 2500 square feet. The addition added another 980 square feet, bringing the total square footage to 3480 square feet. Students measured the surface of the parking lot, from which rain runoff would be captured, to assist in the calculation of the amount of runoff produced from this surface.

Our club was formed with eight committed sixth and seventh grade students who wanted to see the rain garden be constructed at Beaumont Middle School. We wanted younger students so that they would buy into the program and want to see it maintained through their middle school years. Throughout the year, students would come and go and at one point during the construction and installation, Ms. Trahan and Mr. Goff were both able to have a class they teach be involved as well.

Image 2. The butterfly garden after having been marked off. Photo credit: Patrick Goff

Table 1. Data that was collected by students.

Type of Data	Data Collection Method	Amount
Size of rain garden Size of butterfly garden	Measured size of rain garden Measured size of butterfly garden	980 square feet 750 square feet
Size of parking lot	Measured size of parking area	39,000 square feet
Rainfall runoff collection	Calculated amount of runoff from a 1 inch rainfall event	3,248 cubic feet of water
Rainfall volume	Volume of rain garden original Volume of rain garden addition Rough 80% increase in volume	104.11 cubic feet of water could be held 81.6 cubic feet of water could be held New Rain Garden Volume total – 185.71 cubic feet can be held

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Table 2. Timeline of activities during the 2021-2022 school year.

Month	Activities
September	Students went outside and talked about the 2 existing rain gardens, looked at the various plants, snapped pictures of them and slowly worked through identifying what needed to be kept and what needed to be removed.
October	Student lesson "Fight Flooding and Pollution with...a Garden?" The students built and tested models of a miniature rain garden in a plastic bottle. https://www.sciencebuddies.org/science-fair-projects/project-ideas/EnvSci_p066/environmental-science/rain-garden
November	The students met with Bruce Hutcheson to investigate where BMS fits into the Wolf Run watershed through a map.
December	Students measured the size of the parking lot and rain gardens, 130 feet by 300 feet and our rain gardens measured in at approximately 2500 square feet.
January	Students met with our contractor, Nachie Braga, who would build both gardens, to learn about the history of our area and why rain gardens are important.
February	Mr. Braga brought in a list of possible native plants for our students to pick from and talked about the pros and cons of each family type of plant for the gardens. Students then developed a list of plants that would be used. The students were made aware of the fact that the specific plants picked would be dependent on availability and price. Students were aware of the budget so they could understand the constraints on the project.
April	Mr. Braga came in on spring break to do the heavy equipment work of excavation and ground prep work for the rain garden expansion and butterfly garden install. This was done for work vehicles to not interfere with traffic in the parking lots and to not have to worry about students being near the work sites.
May	Planting was started and finished with the help of volunteers from Mrs. Trahsn's science classes.
Fall	Future work includes mulching the gardens, creating signage for both gardens, and creating public service announcements about the gardens.

The students also calculated the volume of water that the rain gardens could hold before and after the expansion. The difference between these two numbers allowed students to realize how much additional contaminated water could be prevented from flowing straight in the Wolf Run watershed.

Three outcomes were achieved at the conclusion of the project. Overall, we effectively increased our rain garden system by approximately 81.6 square feet. That allowed for an additional 185.71 cubic feet of storm water runoff to be held and absorbed, not allowing it to go into the storm water system.

Image 1. The butterfly garden after being planted. Photo credit: Kyla Trahan

Image 3. The area in our walking track where we wanted the butterfly garden after having been cleared. Photo credit: Kyla Trahan

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Outcome #1 – Expansion of Rain Garden

This outcome allowed for an increase in the amount of rainfall that can be captured and diverted from the stormwater system.

Outcome #2 – Creation of Rain Garden Club

This outcome was of great pride for the educators involved because they were able to get 6th grade students to take interest and ownership in rain gardens. The club itself had eight student members but was able to involve about another 35 students in the planting of the materials through class time and school service projects.

Outcome #3 – Water quality improvement for the Wolf Run Watershed

This diversion allows the rainfall that has various pollutants, many from the 50 plus vehicles that park on the parking lot, to be absorbed by the ground prior to entering the Wolf Run watershed.

While the project was able to calculate the amount of runoff from the parking lot and the volume of runoff that the rain gardens could absorb, it did not calculate the rate at which the gardens would absorb the runoff. This additional piece of data will need to be calculated over the Fall and Spring of 2022-2023 school year. This will allow for a better understanding of the amount of water that can be contained within the rain garden. This number will be used to determine future expansion needs of the rain garden.

Conclusion

Long term maintenance of the rain garden and butterfly garden will fall to future students and staff at BMS along with community volunteer members. Our communication was not what had been planned as the timeline of planting was pushed back because of issues obtaining plants and getting money processed through the school district. The current plan is to take the 2022-2023 school year and start publicizing to the school and wider community about the rain gardens and butterfly gardens. The project is also in talks of working with a local elementary school to help them write a grant to Kentucky American Water to install their own rain garden.

There were several lessons learned over the course of the project.

1. Organize meetings better and help guide the students in the process.

Image 4. Nachi Braga, the local environmental consultant, and Kyla Trahan helped plant our rain garden. Photo credit: Patrick Goff

Image 5. The rain garden expansion after having been planted. Photo credit: Patrick Goff

Image 6. Kyla and her students who helped plant the rain garden expansion. Photo credit: Patrick Goff

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About the Authors

Patrick Goff is a 23 year veteran science teacher who works at Beaumont Middle School in Lexington, KY. He has his BS in Secondary Ed Earth/Space Science and a Masters in Administration and Supervision along with his National Boards Science/ Early Adolescence. He has helped to oversee the installation and expansion of the rain gardens at our school. Patrick can be reached at patrick.goff@fayette.kyschools.us.

Kyla Trahan is a 19 year veteran teacher with Beaumont Middle School located in Lexington, KY. Kyla teaches 6th grade science, has a Bachelor's Degree in Elementary Education 1-8 with an add on of PreK- K, a Master's Degree in Arts of Elementary Education, and a Rank 1 in Educational Technology. Kyla can be reached at kyla.trahan@fayette.kyschools.us.

2. Get the planting done either in the fall of the school year OR earlier in the spring so one is not fighting the end of the school year. Project completion was delayed due to the need to remove some invasive plant species and put down the mulch.

In conclusion, it was a great learning experience for all parties involved in the installation of a new rain garden and butterfly garden at our school. We have seen the gardens go from being just an idea to being a real-life rain garden and butterfly garden. Our students are excited at the chance to maintain and improve on what we have done so far. We are also excited that we now know that we have been able to make a difference in the downstream water quality from the rain gardens that have been installed, even if it is a small difference, it is still a difference the students are proud of.

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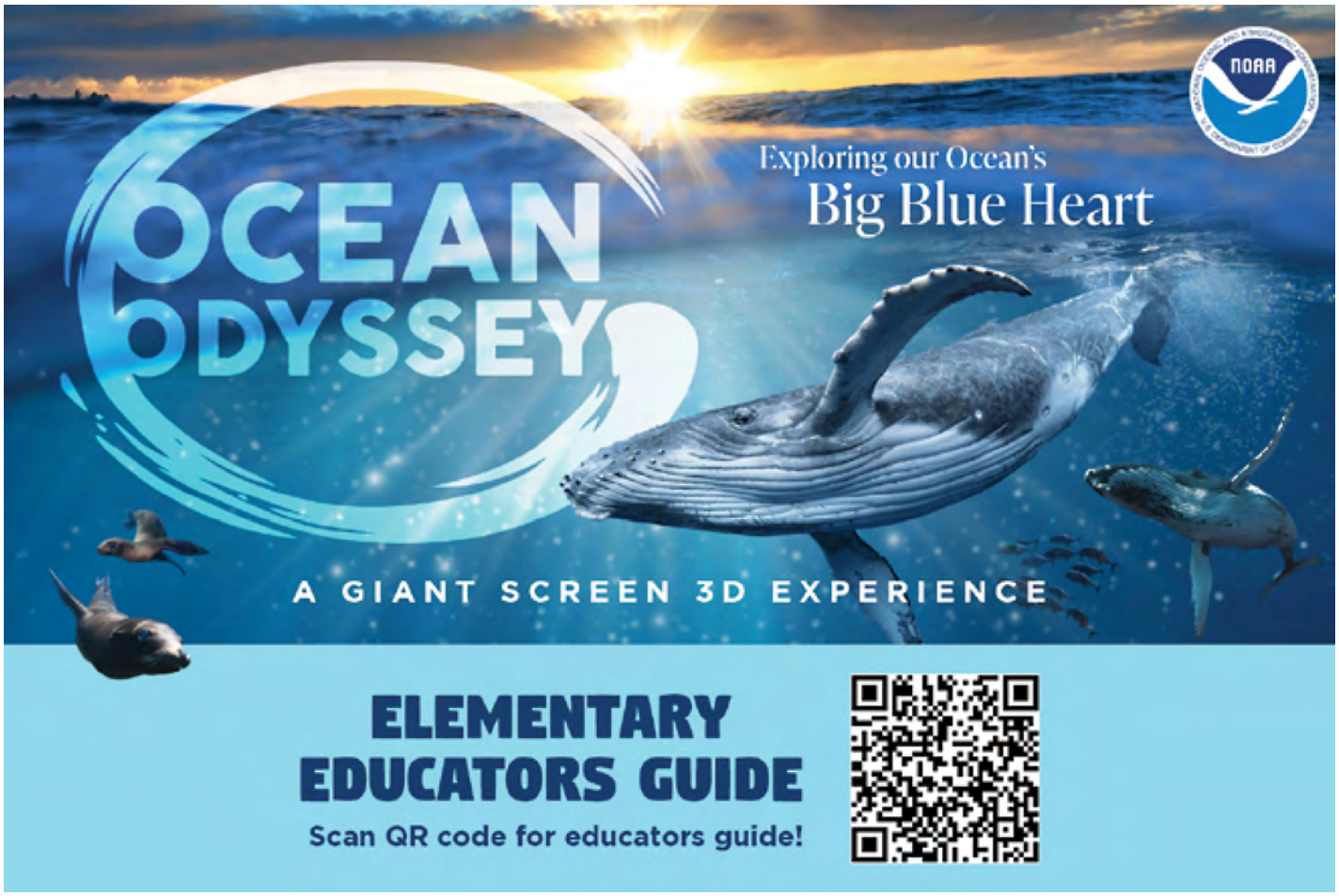

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Keepers of Turtle Island

Amelia Cook, Keepers of Turtle Island
Native Youth Science Club, Norman High School, Norman, Oklahoma

Monarch lands on student at Tribal Alliance of Pollinators Butterfly Sanctuary

Photo credit: Amelia Cook.

Abstract

Keepers of Turtle Island, a clan of Indigenous students, was an initiative to learn more about sustainable practices, revitalize Traditional Ecological Knowledge (TEK) with our Native American communities, and actively engage in stewardship of our environment. This NOAA Planet Stewards project was designed to address the damage caused to the environment in terms of the loss of biodiversity and the growing threat to ecosystems and cultural heritage. One of the main challenges that the project addressed was the decreasing number of pollinators due to various factors including the eradication of native plants such as milkweed. The project restored habitats for pollinators by growing native plants, which provide ecosystem services and opportunities for students to learn about them. The project also focused on reducing carbon emissions and sequestering carbon. By braiding Indigenous Science perspectives into environmental education, the project emphasized relations, responsibility, and stewardship towards the environment. The program engaged middle and high school students in calculating their carbon footprints, planting a native pollinator garden, and learning about the local ecosystem and climate through their Indigenous cultures. The project's partners collaborated with the students to design the garden space and donated native plant species. The project also involved cultural educational experiences to bridge learning about Indigenous culture and science and build participants' climate literacy. The Keepers of Turtle Island project provided culturally relevant and sustaining science learning experiences, built community, and limited the effects of climate change by integrating education, culture, and community approaches informed by Indigenous knowledge.

Introduction

Our relationship with Earth has deteriorated and much of the traditional ecological knowledge of our ancestors has been lost. Rekindling our community relationships through storytelling, listening, and learning through our Indigenous cultures could help increase the climate literacy and sustainability of our local community at large. Indigenous communities are particularly vulnerable to the impacts of climate change with close dependence on climate-sensitive resources for their livelihoods, cultures, and economies. The intimate

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connection with the land and ancestral knowledge of Indigenous peoples accumulated over centuries is a strength. Native people's traditional methods of learning from the land, as well as their practice of passing down these traditions and knowledge through generations, have been recognized by the Intergovernmental Panel on Climate Change (IPCC, 2019) as critical for adaptation. The Panel's report acknowledges the importance of Indigenous knowledge in accelerating societal behavior changes that align with the goals of adapting to and mitigating global warming. Integrating education, information, and community approaches informed by Indigenous knowledge can be an effective means of facilitating widespread adaptation and limiting the effects of climate change.

Today, overuse of chemicals, landscaping, and environmental mismanagement have damaged our lands and deepened the disconnection with nature. This disconnection to the community, both human and non-human relations alike, contributes to the loss of biodiversity and inability to collaboratively solve our environmental challenges, threatening our ecosystem as well as our cultural heritage. It is our responsibility to heal our connection to the land by restoring the native plants that sustain life and rekindling our community relationships. Humans can alter the land to a degree that none before have, but this change does not have to be exploitative. Through community education we have an opportunity to hold ourselves accountable and make an alteration for the better. We must do what we can to foster a relationship of reciprocity with the land and educate youth.

Globally, pollinator populations are shrinking. Several overlapping factors contribute to this disturbing global trend, including habitat fragmentation, pesticide use, and climate change. Pollinators are vital to maintaining healthy ecosystems. Most flowering plants depend on bees, butterflies, and other animals for pollination. Pollinators evolved with native plants, which are best adapted to the local growing season, climate, and soils. Many pollinators depend on specific plant species (e.g., milkweed is critical for the survival of monarchs, without it they cannot complete their life cycle). Milkweed has been eradicated both in agricultural areas as well as urban and suburban landscapes and is one of the reasons monarchs are threatened. Growing native plants adds important habitats for pollinators and supports important ecosystem services.

The level of carbon dioxide in our atmosphere is 419 ppm (NASA, 2023), a level that has not been seen since the Pliocene Epoch. This is due to our ever-increasing emissions and the heat trapping properties of carbon dioxide combined with our vast reduction in carbon sinks from deforestation, monocropping, and the reduction in wetlands ecosystems around the globe. Humanity is committed to some level of climate change, how much the climate changes and how well our communities respond to these changes are up to us and the behaviors we choose. Despite increasing awareness of climate change, our emissions of greenhouse gasses continue to rise.

The Project

Our NOAA Planet Stewards project presented opportunities to explore innovative approaches that blend Indigenous science, community development, and education with Western Science to learn about the local environment. By integrating these different bodies of knowledge, we created new and imaginative community learning experiences that value multiple perspectives, collaboration, and promote sustainability. *Keepers of Turtle Island*, a clan of students, learned about sustainable practices and Traditional Ecological Knowledge (TEK) with our Native American communities, and actively engaging in stewardship of our environment. Reducing our carbon footprints, sequestering carbon, and habitat restoration

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for native pollinators are important environmental challenges and the main focus of the *Keepers of Turtle Island* project.

This yearlong program engaged students in culturally sustaining and revitalizing science learning experiences incorporating Native languages, story work, and cultural and science experts from the community. Students calculated their carbon footprints, learned about the local ecosystem and climate, and planted a native pollinator garden. Students learned about culturally significant plants and native pollinators, how to change their behaviors to reduce their carbon footprint, and discovered ways to sequester carbon through campus gardening and greening unused spaces. These educational experiences provided opportunities to challenge students to think in new ways about Indigenous science, community building, and education as a tool for sustainability. Incorporating Indigenous science perspectives emphasized connection with one another and Mother Earth, as well as responsibility and stewardship. The Tribal Alliance of Pollinators, the South-Central Climate Adaptation Science Center, and the Chickasaw Nation collaborated with middle and high school students to design the garden space as well as donated native plant species. The University of Oklahoma's (OU) Beekeepers Association, a student organization that educates and engages with the community to raise awareness about the importance of honeybees, collaborated on native plant research, facilitated learning activities about the importance and role of pollinators, and helped build our raised beds. Norman Public Schools students involved in the project ranged in age from 6th to 12th grade.

Each meeting of the students followed an experiential learning cycle engaging with the Native American cultures of the students to learn science from an Indigenous perspective. Fall activities included visitors from local Native Nations and storytelling. Loksi, is the Chickasaw word for turtle, became a central theme for the club. Students created, *Earth on Turtle's Back*, a paper mâché collaborative diorama art project that modeled the Canadian River valley and local Cross Timbers ecosystem's flora and fauna on the back of Loksi's shell. Stewardship activities included carbon footprint calculations, the International Student Carbon Footprint Challenge, and a biodiversity survey of campus. In Spring meetings, students learned about local climate change impacts, native and culturally significant plants, and designed, built, and planted a native pollinator garden in collaboration with the OU Beekeepers Association.

The club's curriculum followed an Indigenous Science instructional framework emphasizing land-based, student-centered, active learning with Elders and other Knowledge

Image 1. Lawn before the project. Photo credit: Amelia Cook

Image 2. Students built raised beds for pollinator garden Photo credit: Amelia Cook

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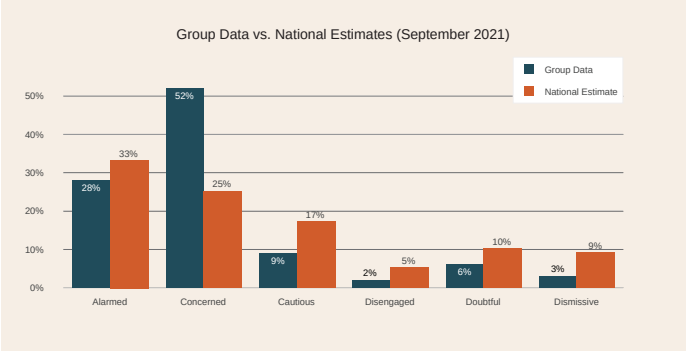
Image 3. Lawn after. North bed with native plants.. Photo credit: Amelia Cook

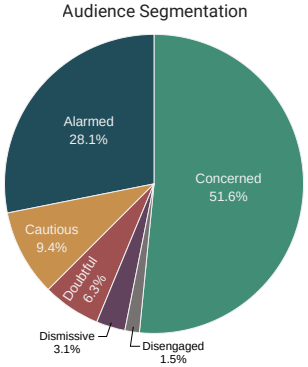
Image 4. Lawn After Project. South Bed with new plants.
Photo credit: Amelia Cook

Image 5. Rattlesnake Master blooming during the first growing season.. Photo credit: Amelia Cook

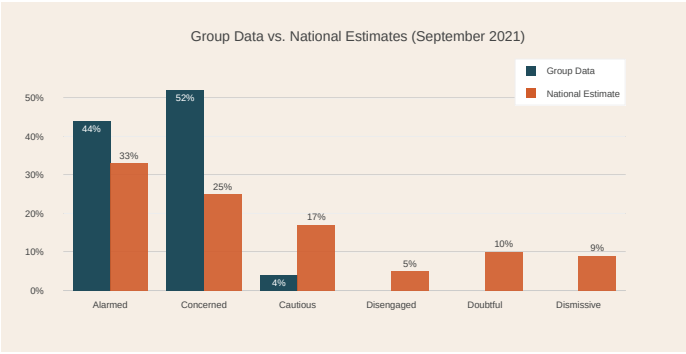
Keepers, science experts, and families in the community, respectfully braiding Western and Indigenous Science perspectives together valuing multiple perspectives, connecting with the past and preparing for the future, building an ecosystem of good relations and practice to investigate and act on a community-based science issue.

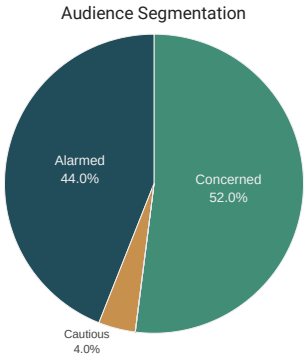
Lessons were developed using experiential learning cycles of experiencing, reflecting, making meaning, and acting phases with a 5E instructional sequence. Participants built relationships with the local environment through Nature Journaling (Laws & Lygren, 2020) activities and cultivating personal and cultural connections in scientific investigations utilizing environmental data (NASA GRACE, 2023) and engaging with community collaborative science programs, Nature's Notebook (https://www.usanpn.org/nn/education) and NASA's Globe Observer (https://observer.globe.gov/do-globe-observer).





Figures 1 and 1a. Climate Change Survey Results Pre-Project





Figures 2 and 2a. Climate Change Survey Results Post-Project

A survey measuring climate attitude and interest was administered at the beginning and end of the school year.

Not all students agreed that climate change was occurring at the beginning of the semester, however, 100% of respondents agreed

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that climate change was occurring in the final survey in May. The group's average confidence in that climate change was occurring changed from somewhat sure to very sure. Overall student opinion regarding if the climate was changing due to human activities changed from a majority agreeing changes were caused "equally by human activity and natural events" to "largely or entirely by human activity." The distribution of students changed in the Six Americas categories (Yale 2021) (Figures 1 & 2) with more alarmed students and no one responding as disengaged, doubtful, nor dismissive at the end of the year. Students reported they still "rarely" talk about climate change but also reported they had more information to discuss climate change at the end of the year. More students reported they believed they could do something and were ready to take action regarding climate change at the end of the year.

There were many significant outcomes of the project. Students learned how to calculate their ecological footprints and increased their knowledge of behaviors to reduce their families' environmental impact. Many students (and parents!) reported changes they were making to reduce footprints, an estimated 10-20% reduction in our collective footprints. *Keepers of Turtle Island* made a measurable improvement in the health of the campus ecosystem. Students completed a biodiversity survey of the area on campus where the pollinator garden was planted before and after the project. Species diversity increased from two plant species to 15 species, and two animal species to six; a 650% increase in plant biodiversity and a 200% increase in animal diversity. The pollinator habitat restoration project added Native and culturally significant plants including:

- Compass plant (*Silphium laciniatum*)
- Rattlesnake Master (*Eryngium yuccifolium*)
- Many-Rayed Aster (*Symphyotrichum anomalum*)
- Leadplant (*Amorpha canescens*)
- Butterfly Weed (*Asclepias tuberosa*)
- Indian Grass (*Sorghastrum nutans*)
- Blue Vine (*Ampelamus albidus*)
- Antelope-Horns Milkweed (*Asclepias asperula*)
- Little BlueStem (*Schizachyrium scoparium*)
- Whiteleaf Mountainmint (*Pycnanthemum albescens*)
- Bee Balm (*Monarda citriodora*)
- Sunflower (*Helianthus mollis*)
- Coneflower (*Echinacea angustifolia*)

Approximately 100 square feet of pollinator habitat was restored increasing the carbon sequestration capacity of campus. Students estimated the new garden would sequester between four to eight pounds of carbon in the first growing season, increasing each year as the perennial native plant species grow in size and increase biomass. Students learned of carbon sequestration in soil and plan to "green" more unused spaces on campus to sequester carbon in soil and plant biomass. The native pollinator garden was planted in a prominent location on campus and has generated a lot of interest from the community. There are plans to build more beds in the future. This garden will continue to inspire and inform the community.

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Image 6. Students planting native plants.
Photo credit: Amelia Cook

Conclusion

The Keepers of Turtle Island project encouraged Indigenous Science and interdisciplinary learning to address local climate change issues and take action on projects, such as restoring native pollinator habitats. By working alongside Elders, local scientists, and subject matter experts, students designed and conducted environmental science investigations, while also learning about the issues through a curriculum that combined Western science with local Indigenous knowledge. Utilizing the knowledge and data they collected, they implemented a stewardship project that targeted the declining pollinator populations, a core climate change issue within the community. As a result of their efforts, there was a significant shift in attitudes towards climate change in participants, cultural knowledge improved, and the ecosystem health of campus improved remarkably.

This project encouraged us to challenge our thinking and embrace new perspectives in science learning. Incorporating Indigenous Science perspectives into environmental education emphasizes connection, responsibility, and meaning.

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About the Author

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NOAA PLANET STEWARDS

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Seminole High School Landscape Architectural Project

Jerry Cantrell, Seminole High School in Seminole, Florida

Monarch on milkweed plant.
Photo Credit: Billy Skaradek

Abstract

The Landscape Architectural Project, an environmental awareness project funded by NOAA Planet Stewards, enabled students to take ownership in designing, creating, and maintaining natural gardens around Seminole High School (SHS). Students had, and continue to have, opportunities to earn service hours, and become leaders within the school community. Approximately 350 – 400 students, 8 educators, a high school administrator, and 2 outside horticulture experts were involved from Pinellas County Schools Gardens and the University of Florida (UF) Urban Horticulture Extension. Restoring Florida native plants to the campus and expanding access to the gardens by educators who have used them for lesson enhancements for their students are measures of success for this project.

Introduction

Seminole High School (SHS) is a 64-acre campus that has minimal vegetation on it. The Landscape Architectural Project was designed for students to build a native landscape promoting shelter and food for native wildlife, biodiversity, and stewardship of nature, and will increase the aesthetic value of the student's educational experience (NOAA, 2021).

Image 1. Seminole High School garden before planting Photo Credit: Jerry Cantrell

A variety of Florida native plants might grow optimally within the 64-acre campus at SHS and provide many benefits. Native plants provide nectar, pollen, and seeds that are important food sources for regional species of butterflies, insects, birds, and other animals (Pitchford, 2019). Native landscaping provides local habitat that is necessary for species that are indigenous to the area (Florida Wildflower Foundation, 2021). Additionally, native plants do not require fertilizer and reduce the need for pesticides. These plants require less water as

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well as prevent erosion (e.g., water runoff and flooding in the local area will be minimized) (US Forest Service, 2021). Finally, native landscaping reduces carbon from the air, which in turn assists in reducing air pollution.

Image 2. Seminole High School propagation garden space prior to improvements Photo Credit: Jerry Cantrell

Image 3. Seminole High School propagation garden space with clearing Photo Credit: Jerry Cantrell

The Project

The Landscape Architectural Project has engaged many educators at SHS and their students in activities relating to the gardens. SHS has used the Landscape Architecture Project to direct a focus on high school-wide STEAM (Science, Technology, Engineering, Arts, Mathematics) education.

The vision of Seminole High School's STEAM program is to develop specialized and innovative skills through exploration, critical thinking, and problem solving (Webster University, 2022), (The Glossary of Education Reform, 2016), (UMass Chan Medical School, 2022). The Secondary STEAM offerings at SHS are rooted in the interdisciplinary application and interaction of all STEAM fields. Real-Life approaches to STEAM-oriented issues are gained through hands-on STEAM challenges and implementation of the engineering design process (Back, 2017). Participation in the STEAM program allow students to:

- Address specific design challenges.
- Use a variety of technologies to enhance their understanding of STEAM tasks.
- Practice communication and leadership skills.
- Explore STEAM careers and their associated pathways.
- Provide avenues for students to use interdisciplinary skills to accomplish learning goals.
- Provide opportunities to compete in the Pinellas Regional Science and Engineering Fair and the Florida State Science and Engineering Fair.

All 85 teachers and 2,000 students have access to use the gardens to teach cross-curricular connections of environmental sustainability as they relate to science, engineering, math, the Arts, and related technologies (Royal Academy of Engineering, 2014). SHS is Pinellas County Schools' first school to initiate STEAM for the entire High School.

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The Sustainable Engineering Academy of SHS uses the gardens to teach unmanned aircraft system operation: filming, light differentiation, ESRI ArcGIS integration based on vegetation as well as water quality data. Language Arts continues to use the gardens to explore nature and interpretation of nature through an author's lens. Foreign language uses the gardening for students to teach how to give directions in Spanish. Visual arts students add artwork to the garden: on the ground, in the trees, and on the walls. Science uses the gardens to demonstrate real world examples of species population and their associated life cycles.

There have been 80 students actively involved in maintaining and cultivating the gardens every week. The species planted are listed in Table 1.

Table 1. Species Planted in the garden

Qty	Description
80	Native Groundcover
50	Native Vine
80	Native Wildflower
60	Butterfly Larval Host Plants
60	Butterfly Nectar Plants
30	Exceptional Pollinator Plant
30	Exceptional Bird Food Source Plant
30	Native Fruit Plants
100	Wildflower Seeds
30	Soil Amendments

SHS is expanding the gardens this year to include a hydroponics garden. Pinellas County Schools worked with the Sustainable Engineering Academy to build out a space that will house the hydroponics system. The goal this year is to begin working on obtaining materials to have students build a greenhouse over the vegetable/propagation garden.

SHS has added CAPE Certifications (industry specific certifications) to its offerings partially because of the Landscape Architectural Project. We offer USI Safety Level 1 Unmanned Aircraft Certification opportunities to students; 33 certifications were obtained last academic year and 60 additional are expected in the 2022 – 2023 academic year. In the next academic year, the Sustainable Engineering Academy is adding ESRI ArcGIS Desktop Entry Certification, AutoCAD Certification, Aquaculture Certification (hydroponics), and Ecology Conservation Certification.

School year timeline:

- Students discussed the launch of the project on May 26, 2021.
- Soil sampling took place throughout the 64-acre campus of Seminole High School. Environmental analysis probeware through Vernier was used along with the student's phones to determine soil pH levels. Students mapped the pH measurements and communicated these to Theresa Badurek of UF. Theresa provided input regarding the soil and plant species that are suitable.
- The soil was sampled in the summer of 2021 (Table 2). SHS worked in collaboration with the University of Florida to accomplish this task.

Table 2. Project Data Collection Types

Type of Data	Data Collection Method	Amount
Soil pH	Probeware detecting pH	3 sites, 10 samples each
Survey of student's interest	Verbal communication and data research for gardening.	40 students
CO2 Sequestration	Measurement and estimation	10 students and 2 teachers

- Students decided that the Landscape Architectural Project will be called SHS Beautify at Seminole High School, August 2021.
- Florida Native Plant Society (FNPS) came to the school and worked with students and educators. FNPS provided guidance on the appropriate plants to place and the times of year to plant them. Additionally, valuable information regarding the vegetable garden and native species to plant was obtained in October 2021.
- Students from the Graphics Media course as well as STEAM Academy created videos for school publication, writings for the school newspaper, and

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communications through the school's The Morning Show to inform and engage students in SHS Beautify Project.

- August 2021, the students planted a butterfly garden and began creating a community space.
- October 2021, students began conditioning the soil of the propagation garden for planting. Students also cleared seashell from the gardens so they could plant the gardens.

Image 4. Seminole High School wildflower garden after planting in 2022
Photo Credit: Jerry Cantrell

- October 2021 - January 2022, (ongoing) students have worked with Wilcox Nursery to design, select, and plant three landscapes at Seminole High School. The students have planted one landscape in front of the school, created an improved memorial garden for students who have passed on as they attended Seminole High School, began creation of a student-centered community space and garden, began planting a shade garden near the auditorium, and began clearing space and improving the allocated vegetable/propagation garden space.
- September 2021, the students were surveyed regarding their understanding of the need for native plants in the local environment during this time (e.g., benefits, aesthetics, how to continue engaging students in activities, their desires to improve and continue gardening efforts).
- September 2021 - current, students are planting suitable sources of nectar and food for indigenous butterfly species
- November 2021 - current, students began propagating a small quantity of native plant species through its propagation garden.
- Academic year 2022 - 2023, students are maintaining the created gardens, building a vegetable garden, and researching aquaponics.

Student surveys were conducted in the fall of 2021 and the spring of 2022 to determine the student's level of interest. The spring survey was used to determine knowledge of the students and was a baseline measurement that will be used as the program moves forward.

Based on EcoMatcher's carbon sequestration formula, the carbon dioxide sequestered in one year was 13,408 lbs (Fransen, 2019). There were more than 570 wildflower plants, trees, shrubs, and vines planted. In the process of restoring native vegetation to the school's campus, 4.62 tons of crushed coquina shells were removed from the memorial garden.

Image 5. Memorial Garden Photo Credit: Jerry Cantrell

Image 6. Wildflowers Photo Credit: Jerry Cantrell

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Many SHS educators wanted to be involved in this project, but curriculum sharing and integration had to occur, so we have taken an approach of collaborating in cross-disciplinary teams. The goal of the teams is to better understand the student's needs and to provide STEAM-centered learning opportunities. A group of educator leaders and administrators met monthly to discuss moving this idea forward. One year's theme for education was "water" and many lessons incorporated a water concept. Each discipline within the school created a "water" project to present to the student body via our Morning Show, a student-created news aired on Wednesdays and Thursdays. There was also a cross-functional team of teachers working with educators regarding the process of building collaborative teams and brainstorm ideas. The educators now see that sharing/integration can be successful and are consistently looking for ways to integrate sustainability into their coursework.

Conclusion

Students have been successful in restoring native wildflowers on SHS's 64-acre campus. There are 5 distinct garden spaces, with plants established over roughly three acres of land. The gardens created at SHS offered valuable teaching experiences that cultivate the potential in every student to thrive as a global citizen by inspiring a love of learning, encouraging civic engagement, challenging and supporting every student to achieve academic excellence, while embracing the full richness and diversity of our community. SHS has used the Landscape Architectural Project to grow its STEAM concept which is improving the teaching and learning environment at Seminole High School. It is also promoting new, innovative, and captivating learning experiences for students.

The Landscape Architectural Project continues to be student-run, provides practical, hands-on experiences in farming and gardening, business management, community relations, and nature observation. Additionally, students are anticipating research projects, scientific inquiry, as well as places for reflection and creativity in the cultivation of the native plant habitat.

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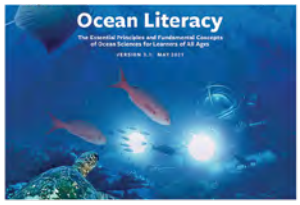

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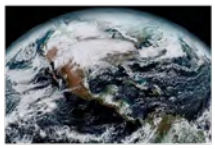

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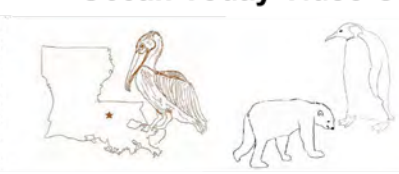


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