

Carbon Footprints, Carbon Sinks, and Carbon Stewardship: A Partnership Between Informal Educators and Classroom Teachers

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Abstract

Pickering Creek Audubon Center of Easton, Maryland, developed and tested an introductory science unit on global climate change in six, fifth-grade classes. Through a series of lessons led by Pickering Creek educators and classroom teachers, students progressed through the topics of carbon, the carbon cycle, greenhouse gases, and climate change. Students learned how our actions affect the global climate, how climate change impacts local habitats and wildlife, and how we can slow the effects of climate change by decreasing our carbon source intake while increasing the planet's carbon sinks. Pickering Creek educators and classroom teachers dispelled common climate change myths and misconceptions, and provided opportunities for students to learn both in the classroom and outside in the schoolyard. Students engaged in age-appropriate climate change solutions by helping decrease their household's carbon footprint, increasing the schoolyard's carbon sink, and by sharing their knowledge with the community and encouraging others to take action as well. Feedback from teachers, school administrators, and the public has been positive and encouraging, and pre- and post-assessment results show an increase in student knowledge regarding climate change topics.

Introduction

Global climate change is a complex topic with far-reaching consequences that is already changing our natural communities. Maryland's Eastern Shore, like many shorelines nationally, will lose habitat for people and wildlife because of rising sea levels due to climate change. Students need to learn about the issue, its impacts, and what they can do to help mitigate the effects of climate change on their current and future communities. This stewardship project implemented the first climate change curriculum at Easton Elementary School (EES) and used a popular festival, the Waterfowl Festival, as a platform for students to teach their community about climate change.

The Next Generation Science Standards introduce global climate change as a core idea in middle school. Pickering Creek Audubon Center secured funding from NOAA's Climate Stewards Education Project to introduce the topic in upper elementary school. This unit, developed for fifth grade science classes, introduces climate change and ties the global issue to their local communities. By providing opportunities for classroom and outdoor learning, a teacher-led class research project, and a platform for students to publically take action and share their knowledge, students were able to teach their own community about climate change, expected local impacts, and initiate

conversations at home about carbon footprints. Although developed for fifth grade science classes, this program can be easily adapted for middle school.

Classroom Lessons and Action Projects

This series of lessons was written as a partnership between informal educators and classroom teachers. Though informal educators led the majority of the lessons, the program is more effective if the classroom teachers get involved early and develop their own class research projects. The unit includes three, hour-long lessons led by instructors from Pickering Creek Audubon Center and a teacher-led carbon footprint calculation and research project. The lessons include: Carbon and Climate 101, Sinks and Sources, My Carbon Footprint, Teacher-Led Class Research Project, and Community Outreach.

Carbon and Climate 101

This introductory lesson covers basic climate and climate change information. We suggest meeting with the classroom teacher prior to the lesson to adjust the material based on the students' background knowledge and to potentially incorporate classroom textbooks and materials.

The lesson includes the carbon cycle, how various carbon-based molecules contribute to global climate change as a greenhouse gas, and what global climate change means for people and wildlife. The lesson also addresses three common misconceptions about global climate change: 1) weather and climate are the same thing; 2) climate change is not impacted by human actions; and 3) cold weather events disprove climate change (McCaffrey & Buhr, 2008).

Sinks and Sources

This hour-long lesson is conducted in the schoolyard and requires permission from the school to install a schoolyard garden. If you install a garden, be prepared for year-round garden maintenance. The most successful schoolyard gardens have support and help from teachers, staff, and parents. Or, as an alternative to creating a new garden, ask to add plants to already landscaped areas around the school.

The lesson starts with a review of the Earth's greenhouse effect, carbon sources, and how we use these carbon sources in our daily lives. Students learn the difference between carbon sources and carbon sinks and expand their school's own carbon sink through planting (Figure 1). The lesson ends with a hopscotch game showing how climate change is causing habitats for birds and wildlife to change faster than they can adapt.

My Carbon Footprint

The classroom teacher leads the carbon footprint lesson. This is a two-part lesson; the first calculation is done prior to the Sinks and Sources lesson and the second calculation is repeated a month later to determine if the student was able to decrease their family's carbon footprint. A "My Carbon Footprint" worksheet can be found at the link provided in the sidebar above. Using the worksheet and online calculator, students determine their current footprint and pledge actions they will take to decrease their footprint and think through how those actions may benefit the environment. Students sign a classroom pledge to be displayed at a public event or in the hallway. The worksheet can be adjusted based on grade level and the chosen carbon calculator. Suggested carbon calculators are listed in the references.

Lesson plans for Carbon and Climate 101, Sinks and Sources, and My Carbon Footprint can be found at the following links:

Carbon & Climate 101:
1.usa.gov/1TwxDHx

Sinks & Sources:
1.usa.gov/1L7y2xl

My Carbon Footprint:
1.usa.gov/1LFn5D0



Figure 1. Expanding the Schoolyard Garden at Easton Elementary School.

Class Research Project

Classroom teachers developed a class research project, with input from Pickering Creek educators, examining the effects of global climate change on local wildlife. We learned it was best to keep the research focus broad so the teachers would have an opportunity to select a topic interesting to them.

Our partner teachers created the following research projects:

- **Local Animal Study:** each student studied a local animal impacted by global climate change and made a model of the animal with recycled materials.
- **Native Plants:** the class created a poster of native plants found in the schoolyard garden. The poster included pictures created by the students and information about each plant and its wildlife benefits.
- **Migrating Geese:** each student created a goose with construction paper and learned about their habitat requirements. The geese were later displayed as a migrating flock in the hallway.

Community Outreach: Sharing Seed Balls and Knowledge

Pickering Creek instructors led the final hour-long lesson. The lesson started with students sharing how they planned to reduce their carbon footprint. The goal of the lesson was to create a way for students to share their new knowledge with the community and give community members an opportunity to take action towards slowing the effects of climate change. The Waterfowl Festival, a local event in Easton, proved to be an excellent platform for the students to share their knowledge about climate change and carbon footprints. Pickering Creek used their exhibit table at the Festival to display the fifth grade class projects to encourage visitors to the Festival to learn about climate change from the students' themselves and to take action like the fifth graders.

Students created six seed balls each using a soil matrix high in clay and a pinch of native wildflower

seeds. Each seed ball was placed in a bag and stapled shut with a message from a student. The students' messages contained facts about wildlife, plants, or climate change, and how planting the enclosed seed ball would benefit wildlife habitat or reduce climate change impacts. Students shared three seed balls with friends and family to encourage habitat creation and spark a conversation about the lesson at home. The remaining seed balls were shared with visitors to the students' display (Figure 2) at the public Waterfowl Festival. Over 1,000 people interacted with the display and 370 families went home with seed balls.



Figure 2. Table at the annual Waterfowl Festival displaying the fifth grader's research projects.

Evaluation and Results

The program was evaluated through changes in student knowledge with a pre- and post-assessment. The assessment covered weather vs. climate, carbon, and climate change and

can be found at (1.usa.gov/1RtmUat). Eighty-four students were evaluated from five classes; the sixth class was not included in the evaluation because the pre-assessment was taken after the first lesson.

The classroom teachers gave the pre-assessment shortly before the program began, and the post-assessment at the conclusion of the final lesson. The mean score (Figure 3) for each class increased while the median score for all students also increased (Figure 4). The mean scores, out of 10 possible points, on the post-assessment ($M=6.917$ $SD=2.387$) were significantly higher than the mean scores on the pre-assessment ($M=4.208$ $SD=2.126$) ($t(83)=7.76$, $p<0.01$).

Discussion

This program provides an effective introduction to climate change. The lessons were designed for fifth graders but can be adjusted, with a few changes, for middle school. Grade-appropriate changes may be best made in the My Carbon Footprint lesson by choosing a Carbon Calculator appropriate for the age (the calculators listed in the reference section represent varying levels of difficulty) when developing the class research topic.

The program can be led by a classroom teacher; however, the partnership between informal environmental educators and the school made the program stronger. Pickering Creek Audubon Center developed the lessons after participation in climate education professional development trainings and was able to provide grant-awarded funding for materials. Classroom teachers provided much needed time outside of the Pickering Creek-led lessons to clarify any questions or prepare for the next lesson. Asking teachers to develop their own class research topic resulted in thoughtful and creative projects, which helped attract visitors to the fifth grader's display at the Waterfowl Festival and allowed both students and teachers to take ownership of the project as a whole. Though we do not know how public opinion or knowledge changed because of the Festival display, it did initiate many conversations over the three-day public event with visitors and staff from Pickering Creek Audubon Center about the school's climate change education and the impacts of climate change on local wildlife.

Conclusion

Knowing their class research projects would be seen by hundreds of visitors at the Waterfowl Festival and that their seed balls would travel the region in the hands of festival visitors kept the students enthusiastic throughout the program. Many students brought their families to the festival to proudly show-off their work and share what they learned. The Festival aspect, in addition to the carbon calculator, worked great at involving students' families in the project.

We started this program prepared to talk with many climate change skeptics, but we have been pleasantly surprised to meet very few. Instead, we have received positive feedback and encouragement from the community to continue climate change education at local schools.

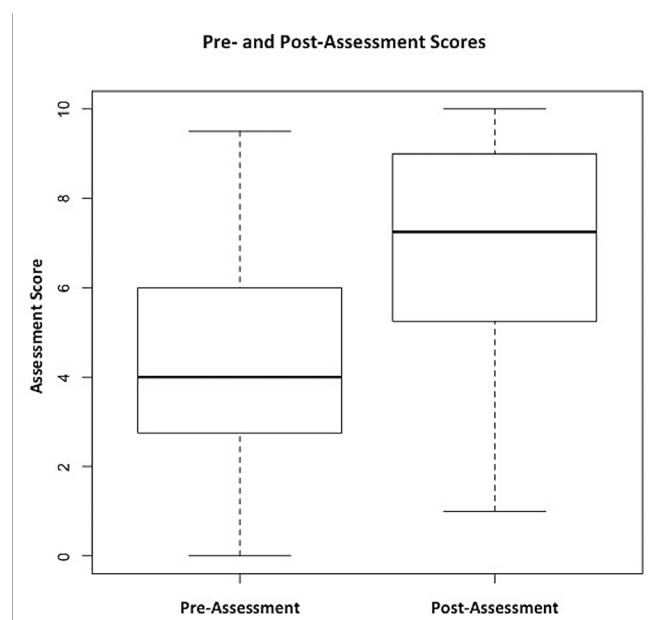
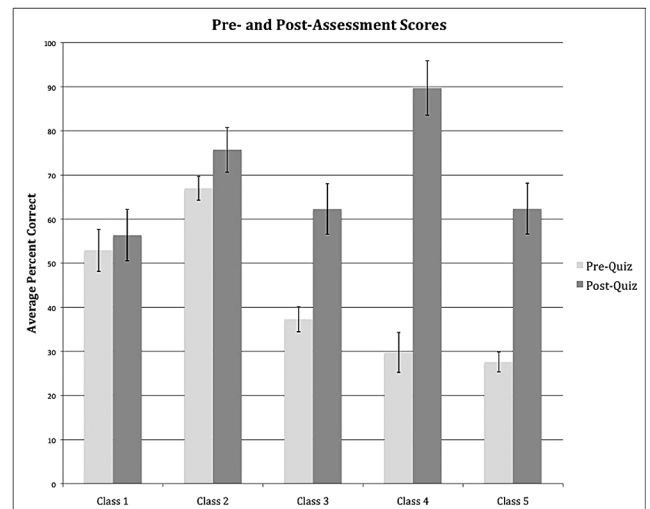


Figure 3 (top). Average scores increased from the pre- to post-assessments for each 5th grade class at Easton Elementary during the Fall of 2014. A total of 84 students completed both the pre- and post-assessment.

Figure 4 (bottom). The median assessment scores increased after completion of the program. Data was collected from 84 students in 5 different classes at Easton Elementary during the Fall of 2014.

About the Authors

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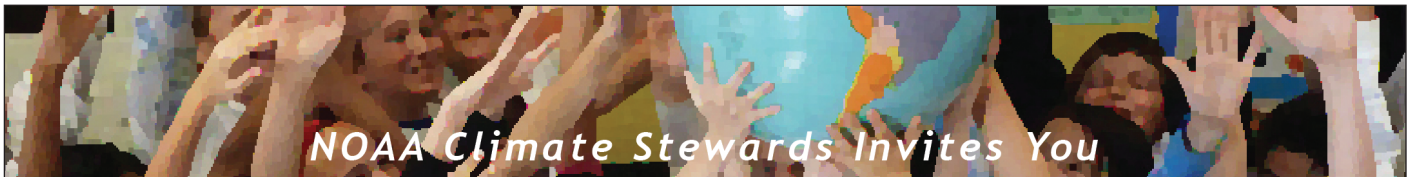
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References

- Zero Footprint Youth Calculator. (2010). In International Education and Resource Network. Retrieved November 10, 2015, from calc.zerofootprint.net
- Carbon Footprint Calculator. (2015). In United States Environmental Protection Agency. Retrieved November 10, 2015, from <http://www3.epa.gov/carbon-footprint-calculator/>
- International Student Carbon Footprint Challenge. (2015). In Inquiry to Student Environmental Action. Retrieved November 10, 2015, from <http://web.stanford.edu/group/inquiry2insight/cgi-bin/i2sea-r1b/i2s.php?page=fpcalc#>
- McCaffrey, M.S., & Buhr, S.M. (2008). Clarifying Climate Confusion: Addressing Systemic Holes, Cognitive Gaps, and Misconceptions Through Climate Literacy, *Physical Geography*, 29(6), 512-528.



CLIMATE CHANGE WORKSHOP SERIES

Saturday, April 2, 2016

National Science Teachers Association National Conference
Nashville, Tennessee
Music City Center, Room 201A.

9:00-10:30 am - Polar Popsicles - Life in the Ice

10:45-11:45 am - Bringing Climate Change Closer to Home: U.S. Forest Service Climate Change Education Resources

12:15-1:15 pm - ClimateChangeLIVE: Engage Your Students in Learning and Being Part of the Climate Solution!

1:30-2:30 pm - NOAA Climate Stewards - Bringing Climate Science into the Classroom

2:45-3:45 pm - Use NGSS as a Pathway to Climate Literacy

4:00-5:00 pm - Climate Games and Simulations

oceanservice.noaa.gov/education/climate-stewards/

