Planting Roots in our Community: Leaving a Legacy Behind

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Abstract

This NOAA Planet Stewards project was designed to reduce the carbon dioxide in our environment through tree planting around the Defiance, Ohio area. Locations included a nature preserve, a therapeutic riding center called Lily Creek Farms, and the Defiance Elementary School, along with local church grounds and backyards. The project was responsible for planting 112 trees with a calculated 1,322 pounds of carbon absorbed for the first year which will continue to grow in years to come. Once the trees are fully grown, they will remove 5,555 pounds of carbon dioxide from the atmosphere each year. Students involved in the project showed an increase from pretest to post-test about their desire to do science, choose a STEAM- related (Science, Technology, Engineering, Arts, Math) career for their future job, and take care of the environment.

The Project

The concentration of carbon dioxide has increased in the world especially after the industrial revolution. Earth's global average surface temperature in 2020 statistically tied with 2016 as the hottest year on record, continuing a long-term warming trend due to human activities. Yearly surface temperature compared to the 20th-century average from 1880–2022.

The town of Defiance, Ohio has a strong interest in reducing carbon dioxide to mitigate the risks of global warming. Defiance City has been recognized by the Arbor Day Foundation for planting trees and is aware of the impact trees have on our community as a whole. Defiance was awarded the Tree City USA Growth Award in 2020. Knowing this information made it easy to decide to focus on planting more trees to help to improve our air quality. In 2020, it was estimated that about 79% of the greenhouse effect is caused by carbon dioxide, a heat-trapping gas that prevents the releasing the heat into space. (EPA, 2021) This excess

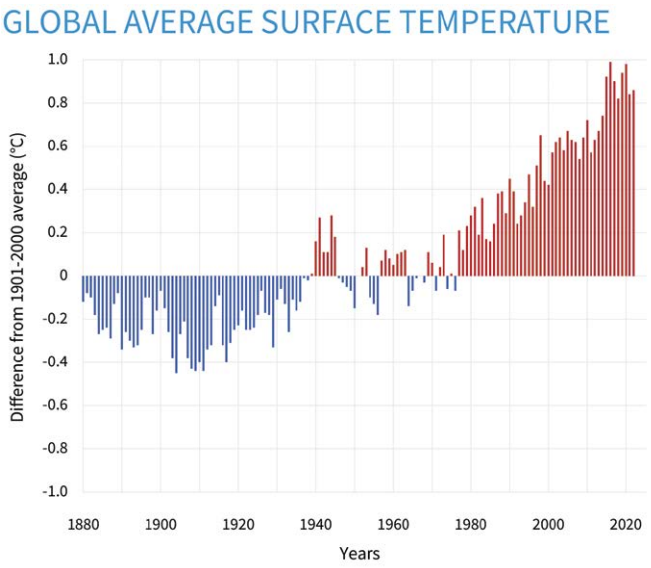
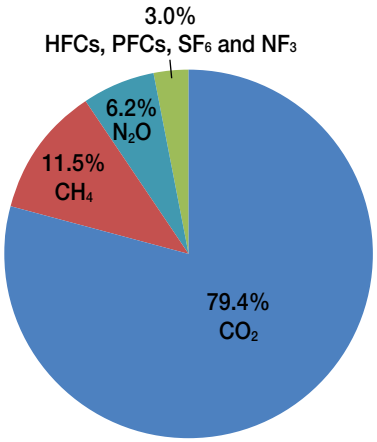


Figure 1. Blue bars indicate cooler-than-average years; red bars show warmer-than-average years. NOAA Climate.gov graph, based on data from the National Centers for Environmental Information.



U.S. Environmental Protection Agency (2023). Inventory of U.S. Greenhouse Gas Emissions and Sinks: 1990-2021

Figure 2. Total U.S. Emissions in 2021 = 6,340 Million Metric Tons of CO_2 equivalent (excludes land sector). Percentages may not add up to 100% due to independent rounding. Land Use, Land-Use Change, and Forestry in the United States is a net sink and offsets 12% of these greenhouse gas emissions. This net sink is not shown in the above diagram. All emission estimates from the Inventory of U.S. Greenhouse Gas Emissions and Sinks: 1990–2021.

greenhouse gas creates a phenomenon known as the "greenhouse effect." Heat from the earth is trapped in the atmosphere due to high levels of carbon dioxide and other heat-trapping gasses that prohibit it from releasing the heat into space.

One way to help reduce carbon dioxide is to plant trees because they act as carbon sinks. We were able to partner with our Soil and Water Department and many other community partners to help with this project, including Defiance Dream Center, YELP, Defiance City Schools, Defiance College, Defiance City, Lily Creek Farm, Defiance Soil and Water, Paulding Soil and Water, and Toledo University GLOBE B-WET.

Image 1. Getting ready to plant trees at Lily Creek Farms, a therapeutic riding center providing healing opportunities through the use of equine-assisted activities. Photo credit: Julie Houck

Image 2. Student at Lily Creek Farm Riding Center. Photo Credit: Julie Houck

Students were a part of a leadership organization called YELP, Youth Engaged Leadership and Philanthropy. This group consisted of students grades 4 – 7 who had an interest in helping in their community. We found a local nursery in the town that helped the students select native trees to plant at an equestrian center called Lily Creek (http://www.lilycreekfarms.org/) where they had trees die along their sensory trail for students with special needs. We planted trees in October and then we were able to go back to measure the trees and do a field trip where the students got to learn about careers on the farm and ride the horses.

Another tree-planting location was a 78-acre nature preserve in Defiance called the Penney Nature Center (https://www.defianceswcd.org/penney-nature-center.html). It consists of wetlands, woodlands, and prairie land. It has an outdoor classroom and provides a nature camp to students over the summer. We were able to partner with the Defiance Soil and Water Department to plant trees there in April with volunteers from our County Commissioner's office and other local volunteers.

Image 3. Penney Nature Preserve in Defiance Ohio where over 100 trees were planted with Defiance Soil and Water.

Photo credit: Julie Houck

Defiance Elementary School was the focus of May tree planting. The local nursery helped students to analyze the soil to determine the best trees to plant and each grade level planted a tree. We collected data using the GLOBE protocols for trees, measuring the height of the trees and the diameter of the trunks. We also estimated how much carbon has been sequestered over the time of the project and the prediction of how much it will sequester over the next 5 years. The students learned about the importance

Table 1. Connections to the Next Generation Science Standards (NGSS, 2013)

Performance Expectation

3-5-ETS1-1 Define a simple design problem that can be solved through the development of an object, tool, process, or system and includes several criteria for success and constraints on materials, time, or cost. (3-5-ETS1-1)

3-5-ETS1-3 Plan and conduct an investigation collaboratively to produce data to serve as the basis for evidence, using fair tests in which variables are controlled and the number of trials considered. (3-5-ETS1-3)

Dimensions	Classroom Connections
Science and Engineering Practices	
Developing and using models • Modeling in 3–5 builds on K–2 experiences and progresses to building and revising simple models and using models to represent events and design solutions.	• Students create a model of a tree (tower) and then measure it using blocks. They will relate how they measure the blocks to find the height of the tower to how they can count the size of themselves to measure a tree height.
Disciplinary Core Idea	
ETS1.A: Defining and Delimiting Engineering Problems **ETS1.B: Developing Possible Solutions** **ETS1.C: Optimizing the Design Solution**	• Students create a model and design a way to measure using nonstandard measurements. They are creating a possible solution and designing a way to measure the height of a tree.
Cross-Cutting Concepts	
Scale Proportion and Quantity • In considering phenomena, it is critical to recognize what is relevant at different size, time, and energy scales, and to recognize proportional relationships between different quantities as scales change.	• Students see the connections between the proportional relationships of the tree to themselves. They also compare nonstandard units to the tower and how these relationships change.

of planting trees, how to measure trees, taking air and surface temperatures, and different STEAM careers. This lesson series provided many ties to the Next Generation Science Standards (NGSS, 2013).

Students created their own class book titled, "What They Want to Be", about their aspirations when they grow up. Students went through the writing process and chose a career that was of interest to them. They peer-edited each other's work and completed final copies were sent off to the publisher. They were very interested in STEAM careers and several picked careers that we had explored during our class career explorations.

Image 4. Student recording her data after measuring the surface temperature and tree data.

Photo credit: Julie Houck

Image 5. Defiance Elementary School tree planting.

Photo credit: Annabelle Houck

Lesson: Engineering for Height https://docs.google.com/document/d/1fjsWBjDTS2CHw0N_TmEGtub-Wt0dX6LUtQPNfNJ4kz4/edit?usp=sharing

Images 6 and 7. Trees were planted at Hebron Ministries in Defiance Ohio. Photo credit: Julie Houck

Additional trees were planted in areas around the community, including a local church and ministry. Native plants and apple trees were planted at Hebron Ministries by volunteers. The apple trees were selected specifically to help with their food outreach program. Trees were also planted in neighborhoods and yards.

During the summer, we were able to share this project with Honor Academy students who represented four different counties (Defiance, Henry, Fulton and Williams) at a week-long camp in Archbold, Ohio. These students also learned about GLOBE protocols and the importance of trees, conducted air and surface temperature measurements, met with a scientist from Toledo University, and went outdoors each day. We used a Terra Rover to collect temperature measurements and compare them to our data.

Conclusion

Over 600 elementary students and 30 volunteers from four local counties (Defiance, Henry, Fulton and Williams County) were involved in this project. The students calculated that this project reduced the amount of carbon (1,322 pounds of carbon for the first year) and the amount will continue to grow in years to come. Once the trees are fully grown they will remove 5,555 pounds of carbon dioxide from the atmosphere each year. Over the span of 40 years there will be over 100 tons of carbon sequestered from this project.

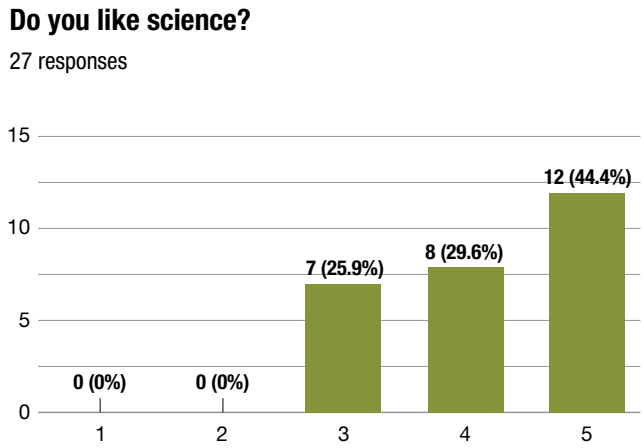


Figure 3. In the year-end survey, 20 out of 27 students selected at or above 4 out of 5 for liking science. At the beginning of the year, 10 students listed liking science at 3 or below.

Students showed an increase from pre-test to post-test about their desire to do science. In the end of year survey, 20 out of 27 students selected at or above 4 out of 5 for liking science. At the beginning of the year, 10 students listed liking science at 3 or below.

Students also grew in their knowledge about the importance of planting trees and in STEAM careers. Multiple presenters such as Joshua Hall, a computer programmer, visited throughout the year in-person or virtually to highlight what they did in their specific job and answer questions from the students. In their book about future jobs, 14 out of 21 students picked a STEAM career.

As a result of the Planet Stewards funding and seeing the impact it could make on my students, I was encouraged to try for an Ohio Environmental Education Fund grant in 2023. The superintendent of my school reached out to me to work on it and I was amazed at the number of community partnerships I had already created. It was fairly easy to continue in my environmental endeavors because I had the experience through Planet Stewards. I do not believe I would have had the courage to write the grant had I not had such a wonderful experience. I also think the community support and ability to partner together made it more manageable to take the next step and my school was selected to receive the Ohio Environmental Education Grant.

I was able to share the results and the impact of this Planet Stewards project on my students and my teaching practice at the 2023 GLOBE (Global Learning and Observations to Benefit the Environment) Annual Meeting in Denver Colorado.

STEAM Careers Presented to Students

- Nurse
- Eye Doctor
- Computer Programmer
- NASA Scientist
- Civil Engineer
- Environmental Specialist
- Candy Maker
- Astronaut
- Equestrian Trainer

Image 8. Joshua Hall sharing about his job as a Computer Programmer.

Photo credit: Julie Houck

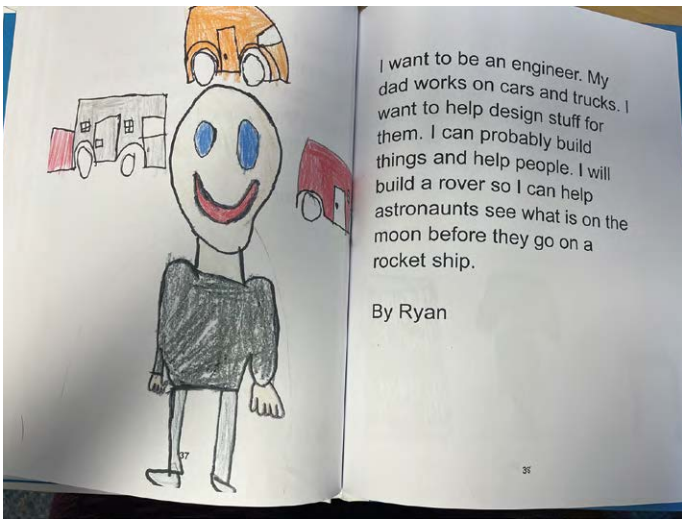


Image 9. Student book page of STEAM career.

From *What We Want to Be* by Mrs. Houck's 2021-2022 Class (Published by Student Treasures https://studentreasures.com/)

References

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About the Author

Julie Houck became a NOAA Planet Steward in 2021. She is a K-5 STEAM Teacher at Defiance Elementary in Defiance, Ohio. She has been teaching for 20 years and has also taught students in Australia, Germany, and China. She earned her Bachelor of Early Childhood Education from Cedarville University and her masters from Regent University. She has been a part of GLOBE Mission Earth for three years and is also a GLOBE trainer. She is a My NASA GLOBE product reviewer, an NSTA member, and an Ohio STEM Learning Network Fellow. Julie can be contacted at jhouck@defianceschools.net.