Project title: The Tiny Forest Project

Project focus area: Carbon Sequestration

Project abstract:
To address climate change and biodiversity loss, we will create a carbon sink, consisting of native plants, on our school's campus. This "Tiny Forest Project" is a densely planted ecosystem where preK-12th grade students can study soil biology, track tons of sequestered carbon, and survey native plant and animal species.

About 25 students and eight faculty/staff will carry out the planning and design. On planting day, about 50 students, a dozen faculty, parents, and community members will join in a workday and celebration. At least 250 students annually will use the tiny forest through the school's Science curriculum. Students will watch the forest grow through their years at the school, cultivating stewardship as they learn about climate change and biodiversity.

What environmental issue will your project address?
The Tiny Forest Project addresses two environmental issues that are arguably the most important of our students' lifetimes: climate change and biodiversity loss.

Nationally, NOAA's observations at Mauna Loa have shown that the substantial dip in emissions at the beginning of the pandemic has disappeared and, as NOAA itself has noted, "2020 was Earth's 2nd-hottest year" (https://bit.ly/3w20vxe). The facts about changes in the global climate, clearly represented by NASA (https://go.nasa.gov/3gicU9R) and NOAA, are indisputable.

At our school when we talk about the Biden Administration goals of lowering emissions by 50% by 2030, we consider how the class of 2030 is now in 3rd grade. This 50% reduction, which the United Nations says is needed for limiting warming to 1.5 degrees, is highly unlikely to happen unless substantial changes are made (https://bit.ly/3z4Z3Mx). Globally, most nations are not meeting the pledges they gave under the Paris Agreement.

Portland, Oregon has had a successful Climate Action Plan in place since 1993 (https://bit.ly/2TL3fky). Even so, the region continues to encounter new challenges to fighting climate change, including the need for cooling centers in low-income neighborhoods. Statewide, our government struggles to deal with climate change because of successive walkouts by opposition lawmakers.

Meanwhile, due in part to climate change, Oregon is entering what is perhaps its worst drought on record. Last summer, climate-change enhanced wildfires burned more acres than ever before. The state government warns us that this fire season may be worse.

The Tiny Forest Project also addresses the stunning losses in biodiversity. The closed canopy woodlands in the Willamette Valley's hills (where our school is located) have become less diverse, as second- and third-generation growth overlook shrub and herbaceous layers dominated by invasive species. These urban forests are surrounded by land being quickly developed as the region urbanizes.

As one study about the Willamette Valley by the U.S. Department of the Interior, Fish and Wildlife Service notes, “Native species and ecosystems may be at an ecological tipping point, as evidenced by the declining populations and range contractions of many native fish, wildlife, and plant species”. Native bee populations are falling because of suburban growth as well as by the climate-change related fires and the use of pesticides over huge swaths of the region (https://bit.ly/3ircEb9; https://bit.ly/3fYuoci). We are also concerned about the health of local butterfly populations, because of declining access to native flora with which they have symbiotic relationships.

How will your project address this environmental issue?
In response to both of the issues we are facing, our school proposes to create a “tiny forest,” a small, densely packed environment of native plants, about the size of a tennis court (https://bbc.in/3fXbLW7). The Tiny Forest Project is designed specifically to serve as a site of carbon sequestration through reforestation. It is a means for our school to address climate change while creating an outdoor “laboratory” for educators. In pursuit of addressing climate change in an educational context, this is an optimal action because it involves hundreds of students--rather than only administrators--throughout the process of planning, implementation, and use, and improves the physical environment of our campus.

The project also addresses biodiversity directly by planting over 600 native plants in prepared soil, plants which will attract native pollinators and other animals. We believe this project can serve as a model for rethinking land use on our 60-acre campus.

The ongoing benefit will be the greatest good this project does. Larger trees store more carbon; monitored soil hosts more microorganisms. (A number of before-and-after pictures from tiny forests in Europe can be seen here: http://urban-forests.com/results-2/.)

Mature flowering plants attract more pollinators, and we are using guidance from Oregon State University’s Extension Service to help us choose the appropriate plants for this work (https://bit.ly/3ppZjBz). As university researchers in the Netherlands have argued, biodiversity within a tiny forest “is expected to increase” over time “due to the establishments of new species and because the trees will provide suitable habitats for a larger number of species” (https://bit.ly/3waXj2k). This is a project that has shown success in restoring biodiversity in communities all around the world (https://bit.ly/3zb9ezs). Once the forest is planted, we will incorporate lessons, such as using U.S. Environmental Protection Agency Greenhouse Gas Equivalencies Calculator, to show students how their stewardship can make a difference (https://bit.ly/34TzY9z).

What are the desired outcomes of your project?
By definition, a tiny forest does not rehabilitate a large swath of land. It is approximately the size of a tennis court. Even so, the carbon sequestration is substantial. According to IVN, a Dutch nature education group, “Wageningen University and Research established that one 200 m2 Tiny Forest sequesters 250 kilograms of CO2 per year” (https://bit.ly/3z9loZm). Of course, this sequestration, set in motion and sustained by students, will continue indefinitely, as long as the tiny forest stands. Secondly, it will improve the biodiversity of both flora and fauna on our campus. By returning over 600 native plants, comprising over 30 different species, to the campus, the project will attract pollinators, birds, and other wildlife.

Who will be involved in this project and how?
Educator and administrative colleagues who will take part in the planning and implementation of the project include our Director of Facilities (name redacted) and Head of Grounds (name redacted). They will collaborate with the Social Studies Teacher (Project applicant - name redacted) on coordination of the project in terms of its impact on the campus, the tools and machinery needed, and in the actual planning for the removal of debris, the improvement of the soil, and in setting up irrigation.

Assistant Head of the Beginning School (name redacted), Middle School Science Teachers (names redacted); Upper School (high school) Science Teachers (names redacted) (who serve as the school's Sustainability Team) will collaborate on organizing student involvement in the construction of the tiny forest. They will also take part in the layout and planting of the project. Director of Community Engagement (name redacted) will offer expertise in reaching out to relevant community partners, including local Native American groups, whose knowledge on edible and medicinal plants will help inform plant choices, and who will advise on issues of Land Acknowledgement procedures.

About two dozen students and eight faculty/staff will be involved in the planning of the tiny forest. High school students (in science courses and a Senior Honors course on American Environmentalism) will work with faculty in research on native plants and those appropriate for the tiny forest. Members of our school's Environmental Action Team student group, which has about 30 members, will also be involved in the preparation of the space, removing tree stumps, weeds, etc., before the planting itself.

On the day of planting, the adults listed above will be joined by about 50 students, representing grades 1-12, in a day-long workday and celebration. Since this project results in a permanent place for environmental education at the school, it's difficult to estimate the number of impacted students, but teachers who work with a total of 250 students per year have already told me they would use the tiny forest in their curriculum right away. They include the teachers listed above and Kindergarten teacher (name redacted).

Explanation of how teachers will use the tiny forest once it is planted is offered in response to questions below.

Whose permission do you need to complete your project?
(name redacted), Assistant Head of School
(name redacted), Director of Facilities
(name redacted), Head of Upper School

The Assistant Head of School is the administrator who has final say over whether the project goes ahead. Our school's Director of Facilities is in charge of the operations of the physical campus and the person whose approval we need to use school-owned equipment as well as to alter the campus. The head of the upper school, as the project applicant's (name redacted) supervisor, is the person with whom he shapes his annual duties. Letters of support from each are uploaded below.

What activities will the project involve?
The proposed Tiny Forest Project at our school is based on the Miyawaki method. Akira Miyawaki is a Japanese botanist and the Director of the Japanese Center for International Studies in Ecology. The Miyawaki method involves planting native plants and trees close to each other in rich, loosely-packed soil free from chemicals or fertilizers. The Miyawaki method can produce forests that grow more than 10 times faster than a traditional forest (https://bit.ly/3w3xh16). The reason for this quick forest growth is that the proximity between plants directs plant growth upward creating a dense space that requires little to no irrigation after two years. There have been more than 1,000 of such forests planted in Japan, India, Brazil, Europe, and elsewhere (https://bit.ly/3ckXUqk). Schools in particular, like Queensmead Primary Academy in the United Kingdom, have embraced the Miyawaki method, using the forests as areas in which students can learn about nature, native plants, and climate change (https://bit.ly/3vUj46y).

When we return to school in September 2021, American Environmentalism teacher (Project applicant - name redacted) will meet with Director of Facilities (name redacted) and Head of Grounds (name redacted) to finalize the schedule for the project, including topsoil removal and improvement. They will check for cables and pipelines underneath the ground, and finalize the precise site for the project.

Seniors will take the lead in revising and implementing the plan, making a final determination of plants included. (Project applicant - name redacted) and the student Environmental Action Team (EAT) will host an “Agriculture in the Classroom coordinator” from the Tualatin Soil and Water Conservation District, to consult with the students working on the design of the tiny forest as well as careers in environmental science and policy. Because plant choices specific to location are crucial, students will communicate with experts from the Portland Nursery, the Xerces Society and Clear Water Services as well as (name redacted) of Scholls Valley Native Nursery.

In October, (Project applicant - name redacted) and his students, in conjunction with EAT, will conduct a soil survey, in consultation with Science faculty (two names redacted). The soil survey is important, since the soil contains microbes, fungi, and other organisms that are all intrinsically connected to the trees and other plants nearby. Students will determine soil texture and quantify biomass. They will learn if the soil is sandy, loamy, or clayey through a ball and ribbon test. Next, testing for nutrient-richness, students (led by Project applicant - name redacted and Science faculty) will determine the water table level to determine if drainage at the site will need to be improved. Finally, following the recommendations of the “Tiny Forest Handbook,” students will measure the health of the current topsoil (https://bit.ly/3psjUoz).

In January 2022, the project applicant’s (name redacted) American Environmentalism students will visit the nearby Hoyt Arboretum to meet with an Arboretum Naturalist to discuss issues and careers in regional forestry, especially as they relate to climate change. These students will also consult with Science teachers, including (three names redacted) on the final design of the space, including paths and seating.

In February, (Project applicant - name redacted) and his students will consult with Head of Grounds (name redacted) on the final amounts and types of soil amendments for the tiny forest.

In March, once the soil supplements are delivered, the school’s grounds crew will excavate the length and width of the tiny forest to the depth of one meter. Half of the dirt and half of the soil supplements will be poured into the trench, and spread over the planting surface. Next, the grounds crew will mix soil supplements with the dirt; then the rest of the excavated dirt will be poured back into the trench and mixed with the rest of the supplements. At the same time, irrigation hoses will be installed on the site.

On a Saturday in March, faculty, staff, students, parents, and other members of the school community will take part in a planting event. Species will be distributed according to the following percentages in order to maximize diversity: the canopy layer will include Douglas Fir and Big Leaf Maple and other species, and these plants will comprise about 20% of the total biomass of the forest. The understory will be made up of smaller deciduous trees, with 40% of all plants belonging to this category. 30% of planted species will make up the shrub layer. Lastly, the herbaceous layer will include about 10% of all plants and be populated with berries and groundcovers. The exact percentages will likely change: our point here is to demonstrate that our goal is creating a complete ecosystem, not just young trees stuck in the ground.

In April, American Environmentalism students will conduct a post-project survey of community members who took part in the project. In subsequent semesters, students in the Environmental Action Team will work together to take care of the tiny forest, monitoring soil moisture and doing the small amount of weeding tiny forests initially require.

Kindergarten teacher (name redacted) plans to use the site to teach her students about native plants and carbon sinks; both of which are important steps in their learning. Middle School students will use the tiny forest to learn about the links between reforestation and climate change. They will study pollination, land use, and botany. High school students will use the tiny forest to compare growth and carbon sequestration, comparing what happens in the tiny forest with that elsewhere on the campus. In addition, teachers across PreK-12, will employ the tiny forest to teach about climate change, botany, and STEM careers including resource management and forestry, a major industry here in Oregon.

Data & Collection Activities:
(Planet Stewards Note - Following review of the proposal, the Planet Stewards Review Team recommended the applicant include the following data collection and reporting activities in an application amendment prior to funding being awarded:

1. *An estimate of the carbon sequestration (measured in pounds) in the existing area with the current foliage in place (prior to the tiny forest being planted).*
2. *An estimate of the carbon sequestration (measured in pounds) of the plants following planting of the tiny forest for the first year following planting, and over the course of their lifetimes.*
3. *A detailed survey of species inhabiting the area now and a follow up survey after the tiny forest is planted (~ six months to a year or as appropriate).*
4. *A proposed maintenance plan for the tiny forest after the funding period has ended.)*

Data collection will occur in two parts. First there will be data collection prior to and during the construction for the tiny forest itself. Second, the tiny forest will be used by faculty at Catlin Gabel School for a number of ongoing data collection projects.

Students (12th graders) will collect data to determine soil type, soil density, nutrients of the soil, and water table level. They will study the condition of the top soil to determine if it will be of use when we mix in our supplements. Because we will likely include some edible plants in the tiny forest, students will also test the soil for toxicity.

Seniors will also work in conjunction with local experts in native plants (including representatives of the Portland Nursery, the Xerces Society, Clear Water Services, and Scholls Valley Native Nursery) to create a master list of available species that typified ecosystems in the hills of the Tualatin River drainage before the American arrival and transformation of northwest Oregon.

Several teachers in the Middle School and Upper School intend to use the tiny forest for data collection. Here are brief summaries of their intentions so far, including the number of students in each given course.

7th Grade Science: 50 students
From (project applicant - name redacted)'s students' interview with teacher (name redacted): "(name redacted) is eager to have his students study phenology, the scientific phenomena related to the seasons, through experiential learning, and he also wants to conduct native-plant-centered labs. He mentioned that one of those labs consists of identifying native plants with UV light, and another looks at the pollination of native plants."

8th Grade Science: 50 students
From (project applicant - name redacted)'s students' interview with teacher (name redacted): "In 8-Grade Science, a significant portion of the curriculum focuses on 'human impact.' (name redacted) wants to use the space to teach about the progression of land over time, as well as how an area that's been wrongly developed, neglected, or ignored can be revived in a way that benefits the environment."

10th Grade Science: 75 students
(name redacted), a science teacher in the Upper School, hopes to introduce a hands-on experiment that would allow students to calculate the amount of carbon dioxide sequestered in a tree per year. Along the way, her students would also learn how to determine the total "green" weight of a tree, the dry weight of the tree, and the total weight of carbon in the tree. Then, they could compare the carbon intake between different individual trees as well as between different species of trees.

Seniors in Climate Change and Ecology Electives: 30
From the letter of support by teacher (name redacted):
"My students and I are in the process of gathering carbon sequestration data about all of the trees on our campus using a combination of GIS software and USDA Forest Service data. ... Students will also use this data set to learn about the tree species on campus and how their growth rates respond to gradually warming temperatures."

Seniors in Globalization and American Environmentalism Electives: 30
These 12th graders will work on implementing the plan drawn up by Seniors from the Class of 2021. They will conduct soil samples, finalize choice and purchasing of soil amendments, trees, and other native plants. They will work on the site, readying it for planting. They will help organize the "planting party" in Spring of 2022. Because these students will be working on the Tiny Forest Project throughout, (project applicant - name redacted) will conduct surveys before and after the project to assess their learning and changes in outlook based on their experience. Such reflection is a key element to the learning process. Additionally, in April, American Environmentalism students will conduct a post-project survey of community members who took part in the project.

Which STEM careers will students learn about during the project?
(Planet Stewards Note - A common error made by applicants completing this section is to focus their discussion of the STEM skills engaged in by professionals who may be involved in projects of this type rather than the careers themselves. Planet Stewards wants career paths and skills students will have to acquire to realize a specific career to be presented and discussed, in addition to the skills STEM professionals are imparting to them during the project)

Some of the relevant STEM career overlaps would involve aspects of landscape management, planning, and design as well as wildlife biology. For example, during the planning and design process,

students would learn about concepts scientists use to evaluate the relative health and value of wild spaces (e.g., biodiversity and ecosystem services), and apply those concepts when selecting the layout of the forest and the mixture of species to plant. To further this learning, we hope (Covid-19 restrictions permitting) to host an “Agriculture in the Classroom coordinator” from the Tualatin Soil and Water Conservation District, to consult with the students working on the design of the tiny forest as well as careers in environmental science and policy.

After the forest is planted, students will monitor its performance on an ongoing basis using the same tools the forestry industry uses to gauge tree health as well as tools developed by the USDA Forest Service to calculate the impact of individual trees on air quality and carbon sequestration. In Spring 2022, (project applicant - name redacted)’s “American Environmentalism” students will visit the nearby Hoyt Arboretum to meet with an Arboretum Naturalist to discuss issues in regional forestry, especially as they relate to climate change.

How will you conduct outreach within your community? Describe your specific communication and outreach plans.

Although the central function of the tiny forest - beyond carbon sequestration - is pedagogical, we are envisioning it as an opportunity to nurture a school-wide community in a post-pandemic context, as campus life returns to normal. Thus, publicizing the project--and the planting day--within the school community is crucial. We’re also hoping the tiny forest acts as a model for other schools, as they expand their focus on climate change and biodiversity. There are hundreds of such tiny forests, carbon sinks that double as educational spaces, especially in India, the Netherlands, and the UK. We hope that sharing our experience with other schools will inspire others to make similar tiny forests on their campuses as well.

Before starting the project, outreach will be toward students, faculty, and staff in the school, as well as parents and families. This has already begun in preparation for this funding opportunity, as (project applicant - name redacted) has spoken at length about the project with administrators, the Director of Facilities, and teachers in the Beginning School, Lower School, Middle School, and Upper School. This communication will continue during the all-school meetings before the school year begins, in August.

Once the school year begins, we will use our division-specific weekly bulletins and our faculty-parent group to reach out to families about the project. The goal of this communication is to enlist younger students (K-8) to take part in the planting day in March, when the tiny forest will actually be created. It is our hope that the planting day is a community-wide event, including families. Seeing their parents engage in fighting climate change directly will be inspiring to students at our school. Throughout the year, the schoolwide Sustainability Team, which includes faculty and administrators, will work to publicize the project.

During the fall and winter, the student environmental organization, The Environment Action Team, will raise awareness among the students and encourage student involvement in the creation of the tiny forest.

The school also has a robust social media presence, especially on Facebook and Instagram, and these platforms will share the planning for the project with the alumni community and with the local media. (We have already had help from (name redacted), Director of Public Relations and Publications as we put together a proposal to create administrative interest.) We will reach out to the local (Portland, Oregon) media to share the project and its goals with the broader community. We will also share news about the project with the local chapter of 350.org.

After the community planting day in March, the project will again be publicized during the school’s

Spring Festival in May 2022. We are planning on inviting children and their parents to visit the tiny forest to see it early in its growth, and to plant a flowering plant on the edge of the area as well, to further connect the children to the site.

In the following months, the school will continue to use its social media presence to publicize the project: this is something that can continue over the following years as the tiny forest grows. (project applicant - name redacted), the school teacher whose blog “The Bigger Picture: Educating Students for the Globalized Present” has been visited by thousands of educators, will focus his professional writing on the project. He also plans to propose a paper for the 2022 Northwest Association of Independent Schools (NWAIS) conference on the experience of creating a carbon sink/biodiversity project at our school. (project applicant - name redacted), who has presented at the NWAIS on sustainability issues before with Head of School (name redacted), is anxious to communicate with other educators in the region about educational issues related to climate change and biodiversity.

Project Budget

Should any funds be allocated to our school, please contact (name redacted), Controller, (email redacted).

Because my school already owns the equipment we will need, from a backhoe to shovels and irrigation hoses, my expenses are purely for the improvement of the soil and the native plants themselves. In conversation with the nurseries from which I will purchase the plants, I have learned that, given the number of seedlings I am purchasing, I am able to transport them myself and not incur a delivery fee.

The prices below will fluctuate depending on availability when the planets are actually purchased in early 2022. The companies we have chosen to purchase from are the following:
Portland Nursery, Portland, Oregon (trees, shrubs)
Scholls Valley Native Nursery, Forest Grove, Oregon (trees, shrubs)
Recology Organics, North Plains, Oregon (compost)
Aloha Feed, Aloha, Oregon (straw)
Lowe’s, Tigard, Oregon (fencing)

Item	**Number**	**Estimated/ Quoted Cost**	**Purpose**
Douglas Fir	50	$95	Trees for the Tiny Forest
Big Leaf Maple	50	$82.50	Trees for the Tiny Forest
Red Alder	50	$72.50	Trees for the Tiny Forest
Oregon White Oak	50	$72.50	Trees for the Tiny Forest
Pacific Madrone	50	$72.50	Trees for the Tiny

			Forest
Black Cottonwood	50	$72.50	Trees for the Tiny Forest
Western Red Cedar	50	$95	Trees for the Tiny Forest
Vine Maple	50	$72.50	Trees for the Tiny Forest
Beaked Hazelnut	20	$50	Trees for the Tiny Forest
Western Hazelnut	20	$50	Trees for the Tiny Forest
Snowberry	25	$50	Shrubs for the Tiny Forest
Thimbleberry	50	$82.25	Shrubs for the Tiny Forest
Salmonberry	50	$82.25	Shrubs for the Tiny Forest
Ocean Spray	50	$72.50	Shrubs for the Tiny Forest
Red Huckleberry	20	$80	Shrubs for the Tiny Forest
Red Elderberry	50	$82.25	Shrubs for the Tiny Forest
Blue Elderberry	50	$95	Shrubs for the Tiny Forest
Black Currant	50	$82.25	Shrubs for the Tiny Forest
Serviceberry	50	$82.25	Shrubs for the Tiny Forest
Salal	20	$60	Groundcover/Flowers
Sword Fern	50	$75	Groundcover/Flowers
Western Trillium	50	$75	Groundcover/Flowers
Red Sorrel	25	$50	Groundcover/Flowers
Wild Ginger	50	$50	Groundcover/Flowers
Oregon Grape	25	$50	Shrubs for the Tiny

			Forest
Pacific Water Leaf	50	$50	Groundcover/Flowers
Mountain Meadow Root	50	$37.50	Groundcover/Flowers
Fringecup	50	$30	Groundcover/Flowers
Inside-Out Flower	50	$54	Groundcover/Flowers
Oregon Iris	50	$50	Groundcover/Flowers
Organic Compost	2 cubic yards	$40	Soil Amendment
Delivery (compost)	--	$100	Compost Delivery
Straw	2000 lbs	$480	Soil Amendment/Mulch
Gravel for Path	2 cubic yards	$110	Pathway through forest
“Sand Fence” (to protect the seedlings and create a barrier)	250 ft	$300	Border/Protection
Total Budget		3055.75	

Note: The Tree for All program at Clean Water Services has already agreed to furnish the school with some native trees (though at the time of this writing, the final number and specific species have not been determined).