Science Societies

Learning through experience with a community greenhouse

College students build and manage a greenhouse to grow food for a K-12 school

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DOWN TO EARTH

Food & Farming Research Explained

Peppers growing in a community greenhouse in Winifred, MT.

> *This article is part of a series breaking down and explaining recent food and farming research for readers of all backgrounds, including those without formal scientific training.*

In 2022, seniors studying horticulture at Montana State University helped a small-town K-12 school incorporate greenhouses into their curriculum. The course let the seniors overcome challenges by designing the growing area themselves and having a real-world effect on food security in Montana.

The course, described last year in *Natural Sciences Education*, allowed students to engage with local communities and face real-world problem-solving opportunities that benefit the communities and the students. Students who take advantage of these opportunities can better understand course content, learn more hands-on skills, and improve their self-confidence. When students work on real-world problems, they are motivated to work harder and try to understand the course work more deeply.

The course in action

This opportunity came from a capstone course for seniors majoring in horticulture at Montana State University where they have to design, plan, and execute a hands-on experiment. The learning objectives for the course were to develop solutions for problems, carry out a horticultural experiment, and present their research.

The K-12 school in Winifred, a small farming community in central Montana, was built with a focus on industrial arts and agriculture. The nearest grocery store is 40 miles away, so vegetables aren't easy to find. The school's community garden and greenhouse were built to supply vegetables to surrounding communities but the school didn't have the expertise to utilize the space properly. Thus, the college seniors designed and troubleshot cropping systems for the greenhouse and engaged in outreach with the surrounding community.

Students were expected to identify limitations and concerns surrounding the greenhouse conditions. The program directors put students in a place where they constantly interacted with people and where the problems they faced would have consequences requiring immediate solutions. The instructors didn't outline any specific problems; they just told the students to take the challenges as they came.

Besides the community greenhouse in Winifred, the students also used the Plant Growth Center on the Montana State campus to understand how each system worked. The greenhouse had rows of elevated buckets filled with tomato plants and a recirculating irrigation system to provide them with water and fertilizer.

Challenges

On their visit to the greenhouse, students were presented with four challenges. Firstly, the materials for the irrigation system weren't assembled yet, and the school's irrigation system had design flaws. The system was designed to pump nutrients from a reservoir into buckets, drain it into a trough, and drain it again through a floor drain. This wasted countless nutrients for the plants, so the students fixed it by returning the excess water into a reservoir tank.

The second challenge was to prevent the water-delivery trays from overflowing. The students were able to adjust the flow rate with tools from local farm-and-ranch stores and built a series of points that regulated the flow. The third challenge was an issue where the lights wouldn't run on the set timers, which meant the plants would be deprived of light. The final challenge arrived when they found out that the water was too alkaline to grow tomatoes. The students took multiple trips to and from Winifred to gather the supplies and conduct the research necessary to fix the alkaline levels. The successful lettuce, tomato, and pepper harvest proved the effectiveness of the tower system. Everyone involved in the experiment agreed the lettuce was delicious, and the bounty was enormous among all vegetables grown.

The course improved the indoor gardening skills of the seniors and gave them hands-on community work for the real world. Thanks to them, the school started using the greenhouse full time as part of its curriculum. The vegetables it produces go directly to the school lunch program, and at maximum efficiency, it can produce 200 heads of lettuce a week plus a regular supply of tomatoes and peppers. This gives the school enough veggies for lunch and extra to sell in fundraisers.

The community greenhouse in Winifred, MT growing lettuce.

Of course, running the facility at full capacity isn't easy. Labor shortages are widespread in Winifred, and the greenhouse needs 20 hours of work a week to run at full capacity, which can't be covered by student visits alone. Despite this, the facility has managed to stay running a year and a half after the project was completed. Students from Winifred and Montana State continue to volunteer, and the facility is now growing cucumbers, snap peas, and strawberries. The K-12 students do better in science by writing age-appropriate lab reports about vegetables growing in the greenhouse.

The lasting impact

Overall, the students who participated in the activity skillfully identified and analyzed problems before developing solutions for them. These exercises increase engagement, leadership skills, and critical thinking when solving problems. Opportunities like these prepare people for careers after college and motivate them to work hard as they see the fruits of their labor right in front of them. When it comes to preparing students for workplace challenges and real-world issues, nothing is better than working with the community.

Dig deeper

The original research from *Natural Sciences Education* can be viewed at:

Tillett, B., Baumbauer, D., Ewen, J., & Luby, C.H. (2024). Establishing an indoor agriculture system at a rural Montana PreK-12 school creates hands-on experiences for college seniors studying horticulture. *Natural Sciences Education*, *53*, e20150. https://doi.org/10.1002/nse2.20150