Culinary Exploration Using the Entire Plant as an Experiential STEM Approach to Teaching Sustainability

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INTRODUCTION

Experiential learning improves STEM engagement and performance, especially when students apply scientific concepts to real problems (Freeman et al., 2014). Food systems offer an accessible context for this work, integrating biological, chemical, environmental, and practical decision-making skills. Sustainability challenges, such as the impacts of agricultural inputs and the large volume of edible plant material discarded during processing, provide rich opportunities for scientific reasoning. Because limited cooking knowledge contributes to household food waste, education and hands-on skill-building can reduce waste (Aschemann-Witzel, 2015), and behavior-focused interventions are especially effective (Reynolds, 2019). This module engages students with whole vegetable plants to analyze morphology, identify sources of waste, and develop recipes that use as much of the plant as possible, connecting scientific principles to everyday practices.

METHODS

Students in a university-level, introductory food-science course completed a multi-stage experiential learning module designed to connect plant biology, agricultural resource use, and sustainability decision-making through whole-plant culinary exploration. Each student group was provided with an intact vegetable plant such as broccoli, cauliflower, corn, or Brussels sprouts, and began by conducting a structural analysis of the plant's morphology. Using guided prompts, students identified edible and commonly discarded components, estimated the mass of waste typically generated during commercial trimming and household preparation, and evaluated how agricultural inputs such as fertilizers, pesticides, herbicides, and water use contribute to environmental impacts across the plant's life cycle. After completing this analytical phase, students developed one or more recipes that incorporated as many plant components as possible, intentionally designing dishes that minimized waste while maintaining culinary feasibility. Students prepared their dishes in the teaching kitchen, documenting their ingredient choices, functional reasoning, and sustainability trade-offs. Peer and instructor feedback occurred during in-class tastings, where students evaluated the sensory attributes, ingredient functionality, and practicality of each dish. Learning was assessed through students' written rationales for recipe development, the quality and feasibility of their prepared dishes, and their ability to articulate evidence-based sustainability decisions during class discussion.

Figure 1. Students preparing entire cabbage plant in the teaching kitchen create new recipes. Photo: A. Vravick, 2025.

RESULTS & DISCUSSION

Students demonstrated meaningful gains in applying sustainability concepts to real food-system challenges through the whole-plant culinary module. Across all groups, students developed dishes that incorporated plant components not typically used in household cooking, such as broccoli stems, cauliflower leaves, Brussels sprout stalks, and corn husks, showing creativity in reducing edible waste. Their written rationales reflected increased understanding of how agricultural inputs, including fertilizers, pesticides, and water use, shape environmental impacts across the food system. Students articulated clear connections between plant morphology, ingredient functionality, and sustainability trade-offs, indicating growth in systems-thinking competencies. All student groups successfully incorporated at least one plant component they initially identified as 'inedible,' demonstrating applied understanding of waste-reduction strategies. During in-class tastings, students engaged in evidence-based discussions about sensory attributes, feasibility, and resource efficiency. Many reported greater confidence in making sustainability-oriented culinary decisions and expressed intentions to adopt whole-plant cooking strategies in their personal lives. Students' written rationales explicitly referenced how fertilizers, pesticides, and water use contribute to environmental impacts, showing increased awareness of upstream sustainability factors. Collectively, these outcomes suggest that the module strengthened both conceptual understanding of sustainability and practical skills aligned with food-waste reduction.

CONCLUSIONS

This module shows that whole-plant culinary exploration effectively teaches sustainability in STEM. Students connected plant morphology, agricultural inputs, and hands-on recipe development to real food-system challenges, applying scientific reasoning and creating strategies to reduce edible waste. Their evidence-based preparation choices and use of typically discarded plant parts demonstrate growth in systems thinking and resource-efficient decision-making. The activity's adaptability makes it a scalable model for integrating food-waste reduction into STEM curricula.

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