Gardens Restoring Our Wellness (GROW)ing a WSU STEM Community

Project Purpose
A team comprised of faculty and staff in the Departments of Biological Sciences, Teacher Education, and the Center for Teaching and Learning propose a project entitled, Gardens Restoring Our Wellness (GROW)ing a WSU STEM Community. The GROW project will redesign three independent undergraduate courses including the Wright State core course, BIO 1050 Biology of Food for nonscience majors, ECE 4100 Science Methods for Early Childhood Education, and ED 6360 Science Methods for Middle Childhood Education for preservice teacher candidates. The courses are in two colleges; however, our team will collaboratively redesign all three courses across colleges, departments, and programs to achieve the following student learning goals:

1. Increase student and community engagement through authentic STEM learning experiences connected to course content around health, gardening, food, ecosystems, community, and sustainability.
2. Cultivate course cultures that promote democratic STEM, where students actively participate in decision-making, reasoning, and explanatory thinking.
3. Integrate innovative technologies to develop students’ capacity to learn and meaningfully connect course content to their lived experiences.

Our transformative pedagogy includes engaging undergraduate students in gardens, democratic science/technology/engineering/mathematics (STEM) practices, and new technologies to increase students’ content knowledge and care for their university and community. Our courses will create opportunities for enactment and application of the content knowledge in the field – the university garden and local school gardens. We want students to move beyond what is important to learn to how and why this content impacts all of our lives.

Background and Current Coursework
Recent Coursework: Our proposed goals emerged from a piloted version of the Biology of Food (BIO 1050) course redesigned and recently taught summer 2016 with approximately 60 students in the SCALE-UP classroom. The purpose of the course is to teach biological principles applied to the nature of food, its production, and use in the human body. It is often a struggle to teach nonscience majors the importance and application of science in our world, especially when students are learning science as a body of knowledge in a traditional lecture course. Dr. Lisa Kenyon, faculty member from Biological Sciences, with the collaboration of staff from Center for Teaching and Learning (CTL) redesigned and transformed this core course to an active, project-based course in which nonscience majors engaged in more relevant content learning about food, gardening, health, and media literacy. Our design approach was to encourage more student buy-in, motivation, and relevancy by investigating a driving question, How Do Our Food Choices Affect Us and Others that connected course content to their everyday life. They were asked to develop a garden project consisting of three components:

1. Authentic Garden Experiences: Students worked together in groups to design, plant, and observe their garden bed at the WSU campus community garden. The teams shared roles in designing, planting, weeding, recording, photography, videography, problem solving, and reporting.
2. OneNote Journal Observations: Each student kept OneNote online observation journal of the garden during the summer. Students were expected to ask questions, include photos of change over time, describe and explain growth changes, connect ideas (digestion, nutrients, organic farming, weight management, sustainability, etc) from class to what was happening in the garden.
3. Garden Media Projects: In small groups, students developed a media project to explain to an audience how and why our food choices affect us and others. Using media techniques to convince an audience of peers, they applied course content and scientific evidence to explain why gardens are important for saving pollinators, supporting mental and physical health, and building community. For example, one group visited an Ohio bee farm to learn about bee pollination, health and disease. They interviewed a beekeeper and developed a video to convince their peers on why we should save the bees. During this
media project, students were encouraged to visit the Student Technology Assistance Center (STAC) a free technology facility to students who would like to create multimedia (movies, podcasts, graphic design, digitization, and more).

At the end of the semester, we administered a survey called, Student Assessment of the Learning Gains (SALG) to measure student’s learning gains and their progress toward the course’s learning outcomes. As shown in Table 1, overall students demonstrated very positive responses to the learning outcomes in this course. More specifically, we saw written responses such as “I used to just know the surface of all this information. Now I understand why and how-which is awesome,” “The garden really put all of the subjects of this course together for me,” “I never really thought about the ways gardening can be beneficial to my mental health before, but after this class I am definitely going to consider planting a garden” “As a group, we had to discover how to problem solve with five other people and I think it worked out lovely,” “I now like biology,” “I can now make more informed decisions,” “I definitely enjoyed learning about how to make a video, that is something that I have never done before” and “Planting the garden was one of the coolest things I have done for a science class. What better way to learn than to plant your own garden!”

Table 1. End of semester, summer 2016 results from the SALG instrument. Percentages of students (n=48) responding in each category.

<table>
<thead>
<tr>
<th>Student Understanding of Content</th>
<th>No gain</th>
<th>Little gain</th>
<th>Moderate gain</th>
<th>Much gain</th>
<th>Great gain</th>
</tr>
</thead>
<tbody>
<tr>
<td>The main concepts explored in this class</td>
<td>0%</td>
<td>0%</td>
<td>2%</td>
<td>31%</td>
<td>65%</td>
</tr>
<tr>
<td>Digestive System</td>
<td>2%</td>
<td>2%</td>
<td>15%</td>
<td>31%</td>
<td>48%</td>
</tr>
<tr>
<td>Nutrients(Carbs, Proteins, Fats, Vitamins, Minerals, Water)</td>
<td>0%</td>
<td>2%</td>
<td>12%</td>
<td>29%</td>
<td>54%</td>
</tr>
<tr>
<td>Farm to Table: Organic farming, GMO, pollination, buying local, sustainability</td>
<td>0%</td>
<td>2%</td>
<td>6%</td>
<td>17%</td>
<td>73%</td>
</tr>
<tr>
<td>Weight Management</td>
<td>0%</td>
<td>4%</td>
<td>15%</td>
<td>23%</td>
<td>56%</td>
</tr>
<tr>
<td>Gardening</td>
<td>2%</td>
<td>2%</td>
<td>4%</td>
<td>21%</td>
<td>69%</td>
</tr>
<tr>
<td>Applying what I learned in this class to other situations</td>
<td>2%</td>
<td>2%</td>
<td>12%</td>
<td>35%</td>
<td>46%</td>
</tr>
<tr>
<td>Using a critical approach to information and arguments I encounter in daily life</td>
<td>2%</td>
<td>2%</td>
<td>15%</td>
<td>33%</td>
<td>46%</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Integration of Student Learning</th>
<th>No help</th>
<th>Little help</th>
<th>Moderate help</th>
<th>Much help</th>
<th>Great help</th>
</tr>
</thead>
<tbody>
<tr>
<td>Instructional approach taken in this course</td>
<td>2%</td>
<td>2%</td>
<td>15%</td>
<td>21%</td>
<td>60%</td>
</tr>
<tr>
<td>How the class topics, activities, reading and assignments fit together</td>
<td>2%</td>
<td>4%</td>
<td>17%</td>
<td>19%</td>
<td>58%</td>
</tr>
<tr>
<td>Teachers use of technology in classroom</td>
<td>2%</td>
<td>2%</td>
<td>17%</td>
<td>12%</td>
<td>67%</td>
</tr>
<tr>
<td>Students use of technology in classroom</td>
<td>2%</td>
<td>2%</td>
<td>21%</td>
<td>15%</td>
<td>60%</td>
</tr>
</tbody>
</table>

Earlier Coursework: ECE 4100 Science Methods for Early Childhood Education and ED 6360 Science Methods for Middle Childhood Education are similar courses across two different licensure programs housed in the Department of Teacher Education. ECE 4100 provides experiences for undergraduate teacher candidates to develop their knowledge, skills, and dispositions for teaching early childhood science at the P-3 grade levels. ED 6360 provides experiences for graduate teacher candidates to develop their knowledge, skills, and dispositions for teaching middle childhood science at the 4-9 grade levels. Both courses are currently active as students are immersed in the field building their capacities to teach science.

ECE 4100 Science Methods for Early Childhood Education. Since the spring of 2015, Dr. Michelle Fleming has teamed with the local community and the College of Education and Human Services (CEHS) to construct learning gardens at five partnering schools including Lange and Smith Elementary Schools in the Oakwood City School District, Dayton Early Career Academy (DECA) Prep Charter School, and Horace Mann PK-6 and Louise Troy PK-5 Schools in Dayton Public Schools. These schools have served as field-
based, experiential sites for the ECE 4100 course. In these schools, the teacher candidates (undergraduate students enrolled in the course) have the opportunity to instruct and collaboratively work with grades PK-3 elementary students and teachers in their learning gardens.

ED 6360 Science Methods for Middle Childhood Education. In the fall of 2015, teacher candidates enrolled in Dr. Fleming’s course had the opportunity to engage in garden-based, democratic STEM practices by co-teaching and writing a learning garden proposal and design with sixth graders at Smith Elementary School. Additionally, these teacher candidates participated in lesson studies where they taught similar content multiple times to ninth graders at Tippecanoe High School in their outdoor classroom and to sixth graders at Horace Mann PK-6 School.

Over the past year, these licensure programs have decreased credits to degree and are in the process of realigning to new national, state, and university standards and policies. As a result, the educational technology coursework was deleted in both programs. With the increasing need to integrate meaningful and intentional technologies, this project would support teacher candidates in both learning and applying new technologies in the field with elementary and middle school students. Additionally as the Next Generation Science Standards (NGSS Lead States, 2013) integrate engineering and mathematics in learning and teaching science, this project will support the redesign and incorporation of integrated STEM in these school learning garden classrooms.

Description of the Proposed Project and Student Learning Goals

With the three project goals (utilization of the WSU and school gardens as learning laboratories, democratic STEM, and meaningful integration of technology) in mind, we plan to continue and improve the BIO 1050 food course, and also redesign, connect, and collaborate coursework across ECE 4100 and ED 6360. Both Drs. Kenyon and Fleming incorporate their garden expertise and democratic STEM framework throughout their coursework currently. We are proposing that we would work as a design team to redesign BIO 1050, ECE 4100, and ED 6360, to achieve the three goals.

Goal 1: Increase student and community engagement through authentic STEM learning experiences connected to course content around health, gardening, food, ecosystems, community, and sustainability.

A unique feature of the proposed GROW project is its emphasis on encouraging students to participate in the Wright State garden and/or local school gardens. Course content is more accessible to students if students are applying the content in an authentic learning context. The GROW project will help support students learning of the content by engaging them in small cooperative groups, gardening experiences, and instructional opportunities (i.e. teaching in local K-12 schools, providing educational outreach on real issues impacting the university and community, etc.). These courses can sustain the Wright State garden space, with the ultimate intent on improving students’ value towards the university as a place of personal care and connection to community.

All courses will follow the Authentic Garden Experience component to learn about designing, planting, observing, and harvesting a garden. One of our interesting findings from the project-based BIO 1050 course, was the strong attention and buy-in from the students regarding the importance of pollination for the production of food. It was an eye-opening experience for why we were planting flowers in our garden. The comment was, “Are we going to eat them?” They learned quickly in this class that we needed to make a shift from not only thinking about food for us, but also others. ECE 4100 and ED 6360 will also incorporate the themes of food, pollination, and sustainability within the course. From using the WSU garden, ECE 4100 and ED 6360 preservice teachers would learn knowledge about gardening, food, pollination and sustainability to take back to the actual classroom and work with elementary teachers and students concurrently in their school gardens.

Since we are collaborating across courses, we must engage in activities that serve the needs across departments and colleges. The GROW project will include one biology course (one section), one early childhood science methods course (three sections), and one middle childhood science methods course (one section) during the 2017 year. In spring, two sections of ECE 4100 will be taught. Approximately 42 undergraduate early childhood education majors will participate in this course. Students will plant food and flowers for their course, while also planting seeds for the BIO 1050 course. In summer, one section of BIO 1050 will be taught. Approximately 70 undergraduate nonscience majors will participate in this course. These students will harvest the seed plants from the spring, plant food and flowers, and also seeds for their course. In fall, one section of ECE 4100 and one section of ED 6360 will be taught. Approximately 20
undergraduate early childhood education majors will participate in ECE 4100 and 20 graduate middle childhood education majors will participate in ED 6360. Once again, these students will harvest the seed plants from the summer, plant food and flowers, and also seeds for their course, continuing the cycle for preparing the garden for the sustainability into the spring 2018 semester. Approximately 152 total students will participate in this gardening project in 2017. We see an opportunity to combine collaborative efforts and engage individual courses in shared practices that will lead to sustained improvements in STEM learning and sustainability of the WSU garden.

Goal 2: Cultivate course cultures that promote democratic STEM, where students actively participate in decision-making, reasoning, and explanatory thinking.

There is a growing movement to improve STEM education in the United States rooted in the need to develop literate citizens and a workforce for solving 21st century problems. To truly learn content and construct innovative solutions to real problems, students must engage in active and meaningful practices where each learner is a valued and validated scholar with the capacity to learn and voice ideas. Creating a classroom culture that supports democratic thinking and decision-making will be similar across courses (Fleming, Kenyon, Kenyon, & Upadhyay, 2015). Students will investigate real world questions specific to their audience. Questions will involve health, saving bees, and community issues. ECE 4100 and ED 6360 will also explore pedagogical questions about why they should teach gardening to elementary and middle school students and how this helps support families, school, and local community.

Goal 3: Integrate innovative technologies to develop students’ capacity to learn and meaningfully connect course content to their lived experiences.

To increase student access to innovative technologies, content and technologies are integrated and connected within and between courses. During the BIO 1050 pilot course, we incorporated two innovative ways to engage students in using meaningful technology, OneNote Journal Observations and the Garden Media Project. The purpose of the integration was for students to advance their technological skills and media literacy. Since this is a nonscience majors course, this also allowed the diversity of majors to embrace and connect their talents and diversity of disciplines, allowing them to broaden their scope of science and technology integration. We had a range of student technology expertise, from media specialists to students who had never used a camera. Although the learning activity proved effective, it also highlighted a need to provide students with a better environment to leverage technology in a meaningful way.

In order to meet this need and build upon the success we saw in BIO 1050, we would like to incorporate the use of in-class iPads to help with the OneNote Journal observations, app-based learning activities (eg. Explain Everything, Garden Almanac, Book Creator, Dragon Dictation, and Scanbot), and the development of the Garden Media Projects. When there is a purposeful integration of mobile devices in the classroom, faculty can maximize the potential to enhance learning (Thinley, Reye, & Geva, 2014). The iPads will be shared in small groups in each of the three courses, as students journal in OneNote and participate in learning activities that leverage these specific apps. The iPads will be ideal while outside in the garden where students take photos, videos, design garden plots, and use various apps to record observations. Each iPad will come with the electronic pencil that will allow for note-taking and drawing observations and/or models in the garden and for classroom activities. It will also provide a cohesive tool for the media project through the use of iMovie. This will streamline the video creation process and enable students to focus on their content and produce polished videos without the need for high-level technical expertise.

Most often, students do not know how to use devices with an educational purpose, but instead use devices as sources for games. This also occurs in the K-12 school system. Schools are adopting 1:1 technology initiatives for student learning, but there is little or no support for teacher professional development. Teachers need more support on how to use technology in meaningful ways to support student technological literacy. As stated previously, the technology coursework has been removed from the education programs to help address the reduction of course credit hours and to promote deepening technological integration methods. By integrating these same components, OneNote and Media development into the ECE 4100 and ED 6360 courses, we are able to bridge technology gaps in an integrated way while learning about STEM and pedagogical practices. This also prepares our preservice teachers for future teaching using technology.
Core Elements Learning Outcomes
A. Innovation
The redesigned courses will:
1. Increase student and community engagement through authentic STEM learning experiences connected to course content around health, gardening, food, ecosystems, community, and sustainability.
2. Cultivate course cultures that promote democratic STEM, where students actively participate in decision-making, reasoning, and explanatory thinking.
3. Integrate innovative technologies to develop students’ capacity to learn and meaningfully connect course content to their lived experiences.

B. BIO 1050 Learning Outcomes: A Natural Science Course for the Core Element Program:
Biological principles applied to the nature of food, its production, and use in the human body. Topics include molecular biology, photosynthesis, cellular respiration, macro- and micronutrients, anatomy and function of digestion, nutrition, food labeling, sustainable food and issues of feeding a rapidly growing human population.
1. Understand the nature of scientific inquiry.
2. Critically apply knowledge of scientific theory and methods of inquiry to evaluate information from a variety of sources.
3. Distinguish between science and technology and recognize their roles in society.
4. Demonstrate an awareness of theoretical, practical, creative and cultural dimensions of scientific inquiry.
5. Discuss fundamental theories underlying modern science.

C. ECE 4100 Student Learning Outcomes: Aligned with the National Association for the Education of Young Children (NAEYC) standards, 2010, and the Ohio Learning Standards (OLS), 2011:
1. Scientific practices, learning progressions, assessment and differentiation to meet the cognitive and affective developmental needs of students. (1c, 3b)
2. Integration of art, music, movement, technology, engineering, and mathematics (STEM), learning preferences, and cultural relevancy. (5a, 5b)
3. Important implications that inquiry, and multimodal learning approaches, theories and evidence-based practices have for the teaching and learning of science. (4b, 4c)
4. Teaching objectives/goals and learning targets that are aligned with the OLS and the Next Generation Science Standards (NGSS). (5b; OLS: ESS.K-3, LS.K-3, PS.K-3)
5. Diverse viewpoints on the nature of science and technology and their application to current societal issues. (6d)

D. ED 6360 Student Learning Outcome: Aligned with the National Science Teacher Association (NSTA Standards, 2012) and the Association for Middle Level Education Middle Level Teacher Preparation Standards (AMLE Standards, 2012):
1. Science instruction and the cognitive and affective development of young adolescents (NSTA 2; AMLE 1a).
2. The important implications that learning theories have for the teaching and learning of science (NSTA 2, 5; AMLA 2c, 4a).
3. The teaching objectives that are in harmony with the character of science, as well as his/her personal view of effective approaches to teaching science and the developmental level of the young adolescent learners for which they are intended (NSTA 2, 5; AMLE 1a, 2c, 4a, 4b).
4. Her/his own view of the nature of science, after looking at several others’ viewpoints, as well as, its relationships to technology, engineering, and mathematics and be able to defend it in a rational way (NSTA 1, 2; AMLE 2a, 2c).
5. Instruction to include both the process and the content of science (NSTA 1, 2; AMLE 2a, 2b, 2c, 4a, 4b).
6. Some of the problems confronting our society that result from applications of science and technology and be able to guide young adolescents as they consider those problems in the context of problem solving and decision making techniques and strategies (NSTA 1, 2, 3; AMLE 2a, 2c, 4a, 4b).

Names of Faculty Involved in the Project and Identification of Contact Person
1. Dr. Lisa Kenyon, Associate Professor. Biological Sciences and Teacher Education, Contact Person
2. Dr. Michelle Fleming, Associate Professor. Teacher Education
Team members will also include Ben Penry and Jonathan Zemmer, from the Center for Teaching and Learning. Ben Penry, a digital technology analyst, will assist with the digital media projects and Wright State garden project. Jonathan Zemmer, an instructional designer, will assist with the redesign of the courses and offer instructional design support for the implementation of the iPad integration and activities.

Assessment Plan

A. Direct and Indirect Measures of Student Learning
The evaluation of the GROW project will be a collaborative effort between the project faculty and staff. Both formative and summative data will be collected in the project to judge the overall impact. The evaluation will ascertain the attainment of the goals. This information will be gathered through individual and focus group interviews with students, pre- and post- tests and surveys, class observations, and performance-based course assessments.

Table 1: Evaluation of the GROW Project

<table>
<thead>
<tr>
<th>Project Student Learning Goals</th>
<th>Evaluation Activities</th>
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</table>
| To increase student and community engagement through authentic scientific learning experiences connected to course content around health, gardening, food, ecosystems, community, and sustainability | Content analyses of course handouts, documents, presentations and student products  
Student pre and post content tests and attitude and self-efficacy surveys (SALG)  
Individual and focus group interviews of undergraduate students about perceptions of the project, learning in gardens as an authentic experience, responsibilities, relationships, and engagement in the university and local community |
| To cultivate course cultures that promote democratic science, where students actively participate in decision-making, reasoning, and explanatory thinking. | Student pre and post attitude and self-efficacy surveys (SALG)  
Systematic observations of students on enacted democratic science practices during class sessions in different spaces (indoors and outdoors, different school sites, etc.)  
Focus group interviews with undergraduate students’ on their attitudes and perceptions of learning and/or teaching science, working with peers, PK-12 students/teachers, faculty, staff, and the local community  
PK-12 student surveys on STEM education interests/attitudes and academic achievement (what they learned from the lessons taught to them by WSU students) |
| To integrate innovative technologies to develop students’ capacity to learn and meaningfully connect course content to their lived experiences. | Student performance-based course assessments:  
1. Interactive Learning Garden Designs  
2. OneNote Interactive Journals of Lived Experience  
3. Digital Media Projects  
Triangulate and synthesize all data looking for common themes and patterns that emerge out of the project. Develop end of project evaluation report to disseminate data and share findings |

B. Strategies for Acting upon the Findings and Communicating the Results to the Faculty
We will use the findings to modify and improve our other courses that can benefit from these methods of instruction. We will also share our transformative pedagogy with faculty in hopes that this will provide them stepping-stones to modify their own courses with using more active-based and innovative technological
approaches. We will also share our results with our departmental chairs and college deans. We will present our results at departmental meetings and seminars, CTL workshops and panel discussions, WSU Teaching for Student Success Symposium, and state and national educational conferences.

References:
