You Say Bee, I Say STEM: A Native Pollinator Integrated Program

Miranda Furrer, furrer@purdue.edu
Hui-Hui Wang, huiwang@purdue.edu
John Orick, orick@purdue.edu
Karen Mitchell, micheka@purdue.edu
Purdue University
615 W. State St.
West Lafayette, IN 47907
765-494-6897

Introduction & Need for Innovation

There continues to be a growing interest in educational programs with science, technology, engineering, and mathematics (STEM) integration, largely due to a need for more qualified STEM educated employees (US News & World Report LP, 2015). One of the main roles involved with a STEM-integrated program is to help youth apply relevant STEM content to solve a real world problem by using design thinking (Cantrell & Robinson, 2002; National Research Council, 2009). Looking at a problem in Agriculture, Food, and Natural Resources (AFNR) provides a great context and strong content for students to apply knowledge and practice critical thinking and evidence-based reasoning skills due to the complex issues facing AFNR, such as the decline in pollinator populations (Pollinator Health Task Force, 2015). Through this Native-Pollinator Integrated Program, students will learn the critical thinking skills and evidence-based reasoning used particularly in STEM fields and apply them to the problem of native pollinator decline.

How It Works/Methods/Program Phases/Steps

This 20-week program was taught by the Master Gardeners (volunteers that focus on home horticulture topics). Master Gardeners (MG) interested in participating attended a Professional Development (PD) event in November 2016 to learn methods of teaching youth, explore lesson plans, and practice with hands-on activities. They applied what they learned to teach the indoor portion of the youth program, which began in February 2017. The program met once per week at the Lafayette YMCA, with at least two students from the 4^{th}-6^{th} grade after-school class. Students participated in a different lesson each class, with varying topic areas. The topic areas included: evidence-based reasoning, material impacts on nature, soil science, plant science, bee, wasp, and fly diversity, bee family identification, pollinators and flowers, engineer and engineering design, weather, and planning a pollinator garden. Lessons are specific in nature, with steps to each activity and materials needed. Each lesson builds upon the previous one, and is designed to help students use reasoning and evidence to make a claim. To ensure relevancy of content, we have looked to the Next Generation Science Standards (National Science Teachers Association (NSTA), 2014). These standards promote teaching in a new way that allows students to actively explore and experience science in a meaningful way. This curriculum has a large focus on science, but it also incorporates the other areas of STEM, technology, engineering, and mathematics. Beginning in May 2017, students were to begin the outdoor portion of the program, which had a focus on pollinator gardens, building and designing a bee nest, and observing bees at a pollinator garden. However, due to lack of participation and commitment of students at the Lafayette YMCA, we were unable to go through with the outdoor portion this summer. There were three students participating in the summer portion at a second program location, taught through a private instructor. These students did not have any bees come to their nests, but they were able to make observations during the summer and many saw other types of insects visiting their nests.

Results to date/Implications

Data has been collected in two areas during this program. One through the Master Gardeners, and the second on the students participating in the program. At the Master Gardener PD event, participants were surveyed to better understand their motivations for teaching the program, their comfort level with topics before and after the training, ways they will use the knowledge

gained during training, and ways to improve the professional development event. Results indicated that the PD event was successful in helping participants feel more comfortable with each topic. Many participants had prior experience with teaching and have become involved with this project due to a concern for pollinators and an enjoyment of teaching youth.

Personal interviews conducted with five Master Gardeners indicate that their main interest in participating in this program was concern for students learning about pollinators. They feel as though this curriculum is important and that someone needs to be teaching it. This curriculum, with STEM integration, helped MGs step outside their comfort zone and think about learning in a different way. Two of the interviewees, formerly teachers, were used to teaching content knowledge, but this program helped them to see the importance of exploring the process that students take to make a conclusion. Teaching this program empowered MGs, of all backgrounds, to learn something new through teaching methods, and at the same time, share their knowledge and expertise with students who have very little experience relating to STEM, pollinators, or evidence-based reasoning. Encouraging MGs to teach in a new and exciting way is what makes this program innovative and successful.

At each program session, students filled out a worksheet during class to list their prior knowledge, hypothesis, reasoning, evidence, and reflection. The data collected from the student worksheets will help us to understand if students are learning scientific reasoning and how well they can apply these topics to the problem at hand. Personal interviews were conducted with three students that participated in the program through a private instructor. We are in the process of analyzing the data from student interviews. To date, the students have not seen any bees visiting their nests, but they are enthusiastic about the program and their summer research project.

Future Plans/Advice to Others

This was a pilot study and this program will be implemented at many different locations in the future. We have had interest from teachers and will be working with them to implement this program at their respective locations. After each initial lesson, instructors provided feedback on how the lesson was received by students and the ease of teaching. Now that the preliminary classes have been taught, we have a better understanding of the program as a whole and where we need to make adjustments for future implementation, such as limiting the use of an accompanying worksheet during the program. Currently, we are in the process of working with the Agricultural Communication department at Purdue University. We are hoping to prepare the curriculum for publishing in early 2018.

Costs/Resources Needed

Project members developed and reviewed all lesson plans. This program has limited costs, to make it more accessible to a large number of teachers with limited budgets. With the lessons already developed, the majority of costs lie with supplies (ranging from a few dollars to ~$30 per lesson). The major cost for the first year was the two-day PD event. All materials were provided to participants, including lesson printouts, binders, supplies, and lunches. Each lessons' supplies were prepared beforehand, so the cost to volunteers was only their time.

References

Cantrell, P., & Robinson, M. (2002). “How do 4th through 12th grade science textbooks address applications in engineering and technology?,” *Bulletin of Science, Technology & Society*, Vol. 22, pp. 31–41.

National Research Council. (2009). *Engineering in K-12 education: Understanding the status and improving the prospects*. Washington, DC: The National Academics.

National Science Teachers Association. (2014). Access the next generation science standards by topic. Retrieved from http://ngss.nsta.org/AccessStandardsByTopic.aspx.

Pollinator Health Task Force. (2015). National strategy to promote the health of honey bees and other pollinators. Retrieved from https://www.whitehouse.gov/sites/default/files/microsites/ostp/Pollinator%20Health%20Strategy%202015.pdf.

U.S. News & World Report LP. (2015). STEM index. Retrieved from http://www.usnews.com/news/stem-index/articles/2015/06/29/the-2015-us-news-raytheon-stem-index?int=a77009.