The Journal of Extension

Volume 53 | Number 4 Article 19

8-1-2015

Fish Farm Challenge Provides STEM Design Experiences for Youth

Robert L. Horton
Ohio State University Extension, horton.2@osu.edu

Patty L. House
Ohio State University Extension, house.18@osu.edu

Recommended Citation

Horton, R. L., & House, P. L. (2015). Fish Farm Challenge Provides STEM Design Experiences for Youth. *The Journal of Extension, 53*(4), Article 19. https://tigerprints.clemson.edu/joe/vol53/iss4/19

Journal of Extension
www.joe.org

August 2015
Volume 53
Number 4
Article # 4IAW6
Ideas at Work

Fish Farm Challenge Provides STEM Design Experiences for Youth

Abstract

In 2014, Monsanto Corporation partnered with National 4-H Council to help inspire and develop professional skills among young agriculturalists. The Ohio State University created Fish Farm Challenge, which engaged more than 8,000 youth across eight states. Youth were taught about worldwide food insecurity and the importance of aquaculture. They were then asked to create a prototype of a fish food distribution system using standard materials within a small-group teamwork setting and guidance provided by trained teen leaders. Survey results indicate that one-third of the youth were more interested in science and agriculture after participating in the 90-minute activity.

Robert L. Horton
Professor, STEM Education
Horton.2@osu.edu

Patty L. House
4-H Extension Educator III
House.18@osu.edu

Ohio State University Extension
Columbus, Ohio

Introduction

By 2040, the world's population will reach nine billion, an increase from the current 7.2 billion and close to a stabilized population of 11 billion in 2100 (United Nations, 2013). Population growth means stressed food production systems around the world. Wild-caught ocean fish are one major source of protein to feed the growing population; however, supply cannot sustain its current or future demand. Consequently, major efforts are underway to ensure the greatest production of fish, and today's youth will be responsible for carrying these methods into the future.

In 2014, Monsanto Corporation partnered with National 4-H Council to create 4-H Ag Innovators Experience to help inspire and develop professional skills among young agriculturalists. Led by The Ohio State University, 2014's 4-H Ag Innovators Experience activity entitled Fish Farm Challenge engaged more than 8,000 youth across eight states in the science of fish farming.

Goals and Methods

The project had two primary goals for the youth participants:

- To create understanding of the value of aquaculture as a sustainable practice for addressing food security (Weeks, 2013) and to interest youth in a form of agriculture they may not have previously considered;

- To learn how engineered solutions can be used creatively to solve problems within a teamwork situation, as advanced by Worker (2013).

Secondary goals included developing an interest in agriculture and science in general, cultivating professional skills, and increasing the awareness among youth about worldwide food security issues. The target audience was youth between ages 8 and 18 who participate in a 4-H-sponsored day camp, overnight camp or after-school program.

The Ohio State University Extension developed a 90-minute project that taught youth participants about world hunger and aquaculture as a potential means of providing low-cost protein and asked them to devise a prototype by which fish food pellets are evenly distributed over a mat representing a tilapia tank. Three 4-H teens from each participating state were trained about the project at National 4-H headquarters, and they in turn trained more teens in their home states to lead the projects. In total, these 155 teens led 145 Fish Farm Challenge events for more than 8,000 youth in Illinois, Indiana, Kansas, Michigan, Missouri, Nebraska, Ohio, and Wisconsin. Youth were also encouraged to record their experience and submit an edited version to a contest; winners will be announced on 2015 Ag Day.

Participating youth were shown a brief video about food insecurity and introduced to the field of aquaculture. Then they were divided into groups of four or five participants, given their supplies, and told about the Challenge.

The remaining time was provided to allow each group to develop a solution to the Fish Farm Challenge, using a guide and other materials based upon the 4-H SET Checklist (4-H National Headquarters, 2007) and other documents. Because design challenge experiences are based on real-world technologies and problems, they help children see how disciplines like science, technology, engineering and math (STEM) are relevant to their lives (Schmitt-McQuitty, Carlos, & Smith, 2014). Moreover, research suggests design challenge experiences help to remove the stigma from failure; instead, failure is an important part of the problem-solving process and a positive way to learn (Cunningham & Carlsen, 2014). Equally important, in engineering there's no one "right" answer; one problem can have many solutions. As noted by Katehi, Pearson, and Feder, (2009), "There is never just one 'correct' solution to a design challenge. Instead, there are a number of possible solutions" (Katehi et al., 2009). Finally, research shows that when design challenge experiences are part of instruction, students become more aware of engineering, science, and technical careers (Householder & Hailey, 2012). This finding is important at a time when the number of American college students pursuing science and engineering education is decreasing.

Indeed, these outcomes were occurring based on comments gathered from observers of the Challenges:

- Kansas—"Living in a landlocked state – it really made youth think outside of their comfort zone, which helped with their creativity. I would say that we rarely found two contraptions/devices made the same!"

- Indiana—"The teen leaders were amazed at the creativity displayed by elementary age youth as they designed and built their feeding distribution system."

- Missouri—"Missouri 4-H youth have truly taken an innovative and realistic approach to the Fish Farm Challenge. Many urban youth have discussed how specializing in agricultural science and technology can increase their employment opportunities."

- Nebraska—"The youth learned to use communication skills and teamwork to build their fish feeders and also learned about all the different things agriculture can offer. Many of them come from a hard home life and educating them on our world's food security interested them in the topic."

Accomplishments and Impacts

Youth participants and teen trainers filled out separate questionnaires about their experiences with the *Fish Farm Challenge*. Both questionnaires were developed and tested by the lead state. Youth participants were asked five questions related to participating in a group activity, whether the *Fish Farm Challenge* sparked interest in science and/or agriculture, and other questions. Their answers, which provided better than 70% positive responses, are as follows in Table 1.

Table 1.

Youth Survey Results

	Statement	Yes	Kind Of	No
1	It was important to work in a group to accomplish the task during the *Fish Farm Challenge*	76%	19%	5%
2	I had to use communication skills with my team in order to accomplish the *Fish Farm Challenge*	74%	21%	5%
3	Fish farming is a good way to increase food production for our world	63%	30%	7%
4	I am more interested in science and agriculture after participating in the *Fish Farm Challenge*	33%	39%	28%
5	I have a better understanding of how to design and create an object to solve a problem	54%	33%	13%

The teen leaders' questionnaire asked five questions taken from 4-H's Common Measures, a standardized system for data collection and measurement used across the 4–H community. Table 2 highlights the results from the teen survey, providing better than 70% positive responses.

Table 2.

Teen Survey Results

	Statement / Question	Strongly agree	Agree	Disagree	Strongly Disagree
1	I think science will be important in	51%	34%	11%	4%

	my future				
2	I think science is useful for solving everyday problems	49%	41%	7%	3%
3	As a result of this 4-H program, I am more interested in pursuing a career in agriculture	35%	25%	33%	7%
4	As a result of this 4-H program, I am more interested in participating in community service projects related to agriculture	41%	45%	14%	0%
5	As a result of this 4-H program, I was able to confidently lead a group in an educational activity	69%	28%	3%	0%

Conclusion

Design Challenge Learning gives students the freedom to collaborate and innovate as they create unique solutions to real-world science and engineering challenges. Students learn scientific concepts as they brainstorm, design, build, test, and redesign their way to creative solutions.

Reinforcing concepts they're learning in school, students develop life skills of creativity, problem solving, design, collaboration, leadership, risk-taking, perseverance, and learning from failure. This open-ended approach leads to the creation of numerous designs, and students are challenged to apply their knowledge, personal experiences, passions, and talents to the process of creating an inventive, team-driven solution. This creates a truly powerful learning experience, where students are intrinsically motivated to learn and feel the success that comes from achieving a goal as a team.

References

4-H National Headquarters. (2007). *4-H science, engineering and technology: A strategic framework for progress.* Washington, DC: United States Department of Agriculture.

Cunningham, C., & Carlsen, W. (2014). Teaching engineering practices. Journal of Science Teacher Education, 25(2), 197-210.

Householder, D. & Hailey, C. (Eds). (2012). Incorporating engineering design challenges into STEM courses. *National Center for Engineering and Technology Education*. Retrieved from: http://files.eric.ed.gov/fulltext/ED537386.pdf

Katehi, L., Pearson G., & Feder, M. (Eds). (2009). *Engineering in K-12 education: Understanding the status and improving the prospects.* Washington, DC: The National Academies Press.

Schmitt-McQuitty, L., Carlos, R., & Smith, M. (2014). Learning and recommendations to advance 4-H science readiness. *Journal of Extension* [On-line], 52(4) Article 4FEA1. Available at:

http://www.joe.org/joe/2014august/a1.php.

United Nations. (2013). World population prospects: the 2012 revision. New York: Author

Weeks, C. (2013). Sustainable aquaculture in the North Central Region U.S.—A review of perceptions and recommendations from the aquaculture community. *Journal of Extension* [On-line], 51(2) Article 2COM1. Available at: http://www.joe.org/joe/2013april/comm1.php

Worker, S. (2013). Embracing scientific and engineering practices in 4-H. *Journal of Extension* [On-line], 51(3) Article 3IAW3. Available at: http://www.joe.org/joe/2013june/iw3.php

---