



## **Aerospace-themed Camp Engages Girls in STEM**

by Sara L. Maas, Charles R. Standridge and Paul D. Plotkowski

Women and members of other underrepresented groups can have successful careers in engineering and technology. However, while women comprise 47% of the labor force, only 14% of professional engineers are women.<sup>1</sup> This discrepancy is fostered by a lack of positive role models and support systems, a lack of knowledge of science, technology, engineering and mathematics (STEM) careers available, and a misunderstanding of the importance of good math and science education in pursuing a STEM career.

The Science, Technology and Engineering Preview Summer (STEPS) Enrichment Program at Grand Valley State University (GVSU) near Grand Rapids, MI, is designed to address these issues.<sup>2</sup> The program supports seventh-grade girls through week-long day camps. About 40 girls attend one of the two sessions that are offered. When students are in a comfortable and nonthreatening learning environment, their self-esteem rises and learning barriers diminish. The students are free to explore new topics, try new activities and cultivate relationships. Because of this foundation, the girls build the confidence to work hard, try new things and are prepared to attain success once they leave the camp. In the past 11 years, 945 girls have successfully graduated STEPS.



### **Three-pronged approach**

The program uses radio-controlled airplanes to help the girls learn about aviation, physics, aerodynamics, chemistry, manufacturing and assembly processes. The girls are mentored by female students in a STEM track, are taught by qualified faculty and are guided by community volunteers to assemble and modify their airplane.

The program has three goals:

1. Build self-esteem, confidence and self-efficacy. At least 20% of the campers report they learned something new about themselves as a result of attending. By instilling confidence in the girls, we hypothesize they will thrive in their current educational environment and will be more willing to try new things in the future.
2. Increase interest in engineering, science, technology and knowledge in these areas. At the completion of camp, the girls are tested on their retention of content in airplane construction and process plans, aerodynamics and airplane parts. Typically, there is a 25% increase in content knowledge in each of the areas.
3. Nurture teamwork. STEPS campers are picked by lottery from a pool of applicants and then are randomly assigned to one of four teams. This format forces the campers to reach out to each other and create new friendships. Throughout the week, the girls learn to rely on their teammates in both one-on-one and group settings. STEPS is a definite bonding experience. As the girls exchange email addresses at the end of camp, we believe this newly-formed support network remains intact as the girls return to school in the fall, return to their families and return to their community.



## **Program components**

STEPS is designed to achieve a balance between technical, developmental and recreational activities for the campers.

The campers are engaged with technical classes in computer aided design, computer numeric control machining, aerodynamics and webpage design. Airplane construction continues to improve each year. The impromptu design class involves designing and building catapults from paper cups. Campers experiment with wing design using soda cans and drinking straws, fold paper airplanes, ride a magic carpet hovercraft and fold origami frogs.

Alcoa Howmet in Whitehall, MI, provides tours, activities and the opportunity to interact with female engineers. Campers visit the Gerald R. Ford International Airport in Grand Rapids, MI, for three different activities. At Rapid Air in Grand Rapids, the campers fly as passengers in a four-seat Cessna aircraft under the guidance of Blue Sun Air of Zeeland Charter Township, MI.

There were 27 first-time flyers in 2012. That year, the campers also toured the Alticor corporate hangar in Grand Rapids, where they were able to watch the landing of both a fixed-wing plane and helicopter. The last stop was a tour of the West Michigan Aviation Academy (WMAA) in Grand Rapids.

Through biomechanics activities, the campers learn about gait analysis and electrocardiogram rhythms. They experiment with motion sensors and electrical impulses of the heart. An alternative energy activity challenges teams to design and build windmill blades. Then, they test their design on a windmill that generates electrical energy.



The camp culminates with a fly night during which each girl flies the plane she built under the direction of a member of the Warped Wings Model Airplane Club of Allendale and the West Michigan Soaring Society.

Throughout these activities, campers are introduced to female role models who serve as counselors, lead teachers, speakers, activity leaders and volunteers. The campers also meet female high school students through a FIRST Robotics demonstration and during the field trip to WMAA. The camp is supported by a female GVSU student worker.

### **Underrepresented populations**

Minority student participation is a priority of the STEPS program. We strive for a minimum level of 30% of members from underrepresented groups. This level has ranged from 14 to 38% since the start of the camp in 2002.

Recruiting for the camp is accomplished, in part, by visiting three racially diverse middle schools in the greater Grand Rapids Public School District (GPSD). We provide classroom presentations to students and interested teachers and attend parent-teacher conferences to meet and interact with teachers and parents. GPSD provides free transportation to the campers. We also developed applications and question and answer pamphlets in Spanish and deliver presentations in Spanish.

STEPS has had the continuous support of GVSU's educational support program, TRiO, which helps students overcome socioeconomic, social, academic and cultural barriers to higher education. The TRiO middle school advisor works to support communication with students, parents, teachers and administrators.



## **Community partnerships**

STEPS has been an exceptional program for over 10 years due to the partnerships created between the STEPS team and the community.<sup>3</sup> Faculty and staff members in STEM-related disciplines from GVSU and the GVSU Regional Math and Science Center have improved and refined camp activities. Members of the West Michigan Soaring Society, the Warped Wings Radio Control Club and two other local clubs provide model airplane building and flying expertise. Their passion for flying shines through in every activity. The camp is also supported by GE Aviation, which is headquartered in Evendale, OH, Discher Design and Development in Zeeland, MI, and Alma College in Alma, MI.

Some of the logistical responsibilities carried out by our partners include corresponding with participants, manufacturing airplane assembly jigs and fixtures, curriculum development, arranging daily activities and services, coordinating fundraising and program evaluation and providing a broad array of expertise in many areas along the way. All partners are dedicated to providing a positive learning experience for campers in an environment that they could not experience in school.

## **Summary**

The STEPS camp for girls entering the seventh grade has provided a summer enrichment opportunity in STEM for 11 years. The program's goal is to increase the number of female engineers, particularly those from underrepresented groups, through building self-esteem, developing teamwork skills and increasing content area knowledge. This has been accomplished through a partnership between the K-12 education community, GVSU faculty and



staff, radio-controlled airplane clubs and local industry. For more information about the summer camp, visit [www.gvsu.edu/steps](http://www.gvsu.edu/steps).

## References

1. U.S. Bureau of Labor Statistics, “Women in the Labor Force: A Databook,” Report 1034, December 2011.
2. Paul D. Plotkowski, “K-12 Outreach Programs in STEM: Strategies for Development and Continuous Improvement,” in Cindy P. Veenstra, Fernando F. Padró and Julie A. Furst-Bowe, eds., *Advancing the STEM Agenda: Quality Improvement Supports STEM*, ASQ Quality Press, 2012.
3. Janice Pawloski, Sarah L. Maas, Karen Myers, Charles R. Standridge and Paul D. Plotkowski, “The Role of an Engineering College in Integrated K-12 STEM Outreach Efforts,” Joint Issue of the *ASQ Primary and Secondary Brief* and *ASQ Higher Education Brief*, February 2010. <http://asq.org/edu/2010/02/engineering/the-role-of-an-engineering-college-in-integrated-k-12-stem-outreach-efforts-.pdf>

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