

Inspiring STEM: Columbus School for Girls *FIRST* Robotics

For years, Columbus School for Girls (CSG) has prepared young women for future STEM (science, technology, engineering, and mathematics) careers. Since 2001, high school students from CSG and engineering undergraduates from The Ohio State University (OSU) have participated in the *FIRST* (For Inspiration and Recognition of Science and Technology) Robotics Program. The CSG group, Team 677, nicknamed Murphy's Outlaws, designs and builds a robot from scratch through six weeks in January and February to then go up against teams from all over the country at competition.

The *FIRST* program, which unites the nation's leading companies and universities in an effort to introduce young minds to the wonders of science, technology, and engineering, has had a significant impact at CSG. Yearly, between 25 and 35 girls, or 12 to 17% of the high school population, participate in *FIRST* robotics. The impact of *FIRST* becomes clear when one looks at the CSG student population in general; 31% of the all CSG graduates over the last four years have planned to study a STEM field as compared to the national average for young women of 15%. More impressively, around 13% of our school's graduates have planned to study engineering - over five times the national rate of 2.5% of female high school graduates.*

Given these impressive statistics, the team was also interested in further investigating the impact of participating in the *FIRST* robotics program on future educational and career choices. So, in January 2013, *FIRST* Team 677 sent a survey to 76 team alumnae dating back to the team's inaugural year, 2001.

***FIRST* Team 677 Alumnae Survey Findings**

Of the 76 alumnae recipients, almost 50% responded, already indicating the positive impact and value that the *FIRST* robotics program provided to its team members. The survey results suggested that students who were on the team surpassed the average number of girls in the United States who excelled in STEM fields, with 76% of Team 677 alumnae respondents receiving or anticipating receiving a STEM undergraduate degree. Furthermore, of the 37 responses, 73% have pursued or are pursuing graduate degrees, 43% of which are STEM specific. The advanced degrees include four M.D.s, one J.D., and four Ph.D.s in STEM fields.

Further analysis of the responses explained why participation in *FIRST* had such a large impact on team alumnae. The graduates felt a deep connection to the team, with 91% of the alumnae indicating that the experience was very or extremely meaningful, and 97% being very likely or extremely likely to recommend participation on the *FIRST* robotics team.



I've found that I gained invaluable experience in the basics of the design process, teamwork, and, as a captain, team leadership. In college, I was able to rely on this foundation when participating in-group projects and when interning at Cummins. Through my participation on Team 677, I also learned how to safely work with a variety of power tools, which served me well when working in the machine lab at college. As a female in the male-dominated field of engineering, my group teammates were usually all men, but due to my experience with the tools in the machine lab, I was always confident when working with my project group and contributing to the building of the project prototypes.

*Barbara Hubler
Class of 2007*

"It was Team 677 that solidified my interest in science and engineering."

"The opportunity to participate in an extracurricular science and engineering activity was very important to me... While I ultimately ended up in science [geology]; the skills I learned from FIRST have been incredibly valuable."

Over 40% of alumnae have supported *FIRST* since graduation, including by assisting with competitions and by mentoring teams. (Two of CSG's current mentors are Team 677 alumnae.) Survey responses show that the former team members valued the fellowship, engagement, connect- edness, and empowerment of Team 677 most. Many responses high- lighted the special collaboration between CSG students and the OSU mentors.

"Team 677 is a unique FIRST team in the way the mentors, faculty, and team members all work together to form a very functioning team."

"[...] the mentors encouraged us to be as hands-on with the robot as possible. You could tell that wasn't the case with every team."

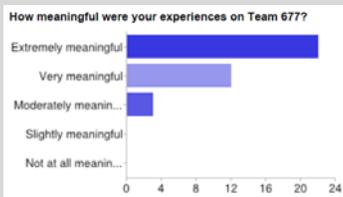
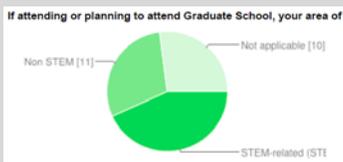
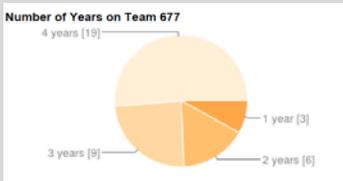
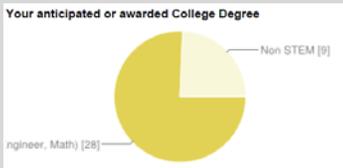
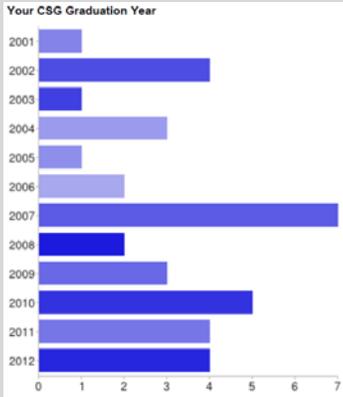
"I liked being able to build the robot ourselves, even when we screwed it up."

Former members particularly appreciated the experience of working first-hand on the robot. When asked what they enjoyed most about their participation in *FIRST* robotics, common responses included teamwork, interaction with mentors, hands-on use of machines, problem solving, and creating a functioning machine.

"We were taught and trusted to use machinery- lathes, drills, mills, drill presses, saws, etc., when most other circumstances would not allow young women to use them [...] Everyone worked for a common goal- to make the most [extraordinary] robot to ever play the game."

"Team 677 allowed me to explore a completely different skill set while also providing leadership training in a cooperative, completely experiential learning environment."

Team members also greatly valued teamwork, time management, team leadership, critical thinking, brainstorming, problem solving, meeting deadlines, communicating, the rewards of hard work, and other crucial skills not directly related to STEM fields.



The alumnae responses clearly demonstrate that *FIRST*'s mission has been realized in all aspects and exceeded nationwide rates of STEM interest.

About the CSG Team 677

Team 677 is one of very few all-girl teams from across the country participating in a competition largely dominated by teams consisting primarily or entirely of boys. In addition to their excellent mentors, the team even has access to engineering and manufacturing facilities at OSU's Center for Automotive Research (CAR), where the girls work directly with professional-grade tools. Furthermore, the team is structured so that each girl has a vital role and forms a close connection with *FIRST*. Given the fact that the team is comprised entirely of students (from both CSG and OSU), Team 677 has a unique sense of community and camaraderie.

However, Team 677 could not exist without generous contributions from its donors. Local companies such as American Electric Power (AEP), Roush Honda, and Time Warner Cable have been the largest and most consistent supporters, though The Ohio State University has generously provided mentors, build space and tools. Additionally, the Patricia T. Hayot Fund for Science and Robotics generates endowment income to assist with the program. Annual Giving donations are also vital sources of support for this program.

About Columbus School for Girls

Columbus School for Girls is an independent, college-preparatory day school located just east of downtown Columbus in Bexley. It was founded in 1898 and serves diverse central Ohio students from infancy through grade 12. CSG is a leader in educating girls and young women and a vibrant community of more than 575 students, 95 faculty members, and 2,500 active alumnae.

Even before joining Team 677, CSG students of all ages have opportunities to prepare for a future in science and technology. The robotics program at CSG begins in Lower School with *Golly Gee Blocks*, a 3D design tool, and opportunities to work with the WeDo and NXT LEGO® robotics programs to gain basic foundations in programming. In the Middle School, students can join the *FIRST* LEGO® League competition using the LEGO®-based Mindstorms® platform. Finally, in the Upper School, the CSG robotics experience culminates with the *FIRST* Robotics Competition.

About the *FIRST* Program

Dean Kamen, inventor of the Segway® and portable dialysis machine, created *FIRST*, For Inspiration and Recognition of Science and Technology, in 1980. He created *FIRST* to inspire young people to become involved in the science and technology fields through competition and mentor-based leadership. *FIRST*'s stated vision is, "To create a world where science and technology are celebrated [...] where young people dream of becoming science and technology heroes."

Team Awards

*2012 Mentor of Year
(Bill Springer) CORI
Summer Invitational*

*2012 Dean's List
(Jessica Greer '13)
Buckeye Regional*

*2008 Woodie Flower's
Award (Elizabeth Car-
ruthers) Boston Region-
al*

*2008 Volunteer of the
Year (Mikell Taylor '02)
Boston Regional*

*2006 Judges Award
Buckeye Regional*

*2004 Virginia Daimler
Chrysler Team Spirit
Award*

*2002 Illinois Kleiner
Perkins Caufield and
Byers Entrepreneurial
Award*



Murphy's Outlaws at 2012 competition

To learn more about Team 677, contact Dr. Kevin Sweeney at ksweeney@columbuschoolforgirls.org, or email the team directly at firstteam677@columbuschoolforgirls.org

Website: <http://firstteam677.wordpress.com>

Facebook: <https://www.facebook.com/FIRSTTeam677ColumbusSchoolForGirls>

Twitter: https://twitter.com/FIRST_Team_677

About the authors

Dr. Kevin Sweeney is an Upper School Science Teacher at Columbus School for Girls and has been overseeing the *FIRST* Robotics program at CSG as Lead Advisor since 2005. After receiving his doctorate in engineering from the Aachen University of Technology (RWTH) in Aachen, Germany, Dr. Sweeney worked as a Technical Specialist for Ford Motor Company's Aachen Research Center. He then was named a AAAS Science and Technology Policy Fellow, during which time he worked in the Engineering Education and Centers Division at the National Science Foundation. Dr. Sweeney came to the Columbus School for Girls from Miami University, where he was an Associate Professor in the School of Engineering and Applied Sciences. Since early in his career, Dr. Sweeney has been active in attempting to increase participation in STEM fields by traditionally underrepresented groups.

Dr. Linda Jacobs Swarlis, Ph.D. is Director of Information Services and Libraries at Columbus School for Girls and has been a *FIRST* Robotics Advisor since 2011. Dr. Swarlis has a keen personal interest in activities that improve spatial skill for girls. Part of her dissertation research included research into the role of spatial skill in academic achievement in the STEM fields. Research suggests that the more spatial skills can be developed and improved, the higher the possible achievement in STEM fields. Robotics is an activity that significantly strengthens spatial skill and Dr. Swarlis is thrilled to be a part of the *FIRST* Robotics program.

Ann Beeson, Partner and Marketing Consultant for Waterfall Holdings Ltd, joined the team as Parent Advisor in late 2012 with focus on marketing, sponsorship and media. Ann has an MBA and success in generating revenue and market share growth in consumer and business segments for The Columbus Dispatch, Lexis Nexis and IBM business partners. Passionate about Columbus School for Girls, she is a past chair of their scholarship fundraiser Jubilee. As an advocate for Team 677, Ann supports their mission for outreach and sponsorship.

* Dr. Linda J. Sax, UCLA Graduate School of Education & Information Studies *Women Graduates of Single-Sex and Coeducational High Schools: Differences in their Characteristics and the Transition to College*, March 2009.



CSG student Claire Sharpe works on a robot component



CSG students Evlin Hogan (left) and Katelyn Lennon (right) measure a part



CSG student Katelyn Lennon (center) explaining a robot design.

Pictured from left to right: CSG students Allyson Coble, Briena Breckenridge, Autumn Pu, Katelyn Lennon, Evlin Hogan, and Molly Thomas