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Virginia Association of Counties

2014 Achievement Awards

Call for Entries

2014 VACo Achievement Awards

Deadline: June 2, 2014

Application Form

All applications must include the following information. Separate applications must be submitted for each eligible program. **Deadline: June 2, 2014.**

Program Information

Locality Chesterfield County

Program Title Robotics in the Library: Hands-on STEM Learning for Teens

Program Category Health and Human Services

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Overview

Ready, set ...battle! As the crowd cheered, the Chesterfield County Public Library (CCPL) LibraryBots team robot attempted to climb a ramp, stack blocks, raise a flag and hang from a pole. Each "battle" lasts two and a half minutes; however, hours of thinking, planning, working and reworking have gone into this competition. At the First Tech Challenge (FTC) Central Virginia Qualifier at St. Christopher's School, in Richmond, Virginia, on December 7th, 2013, LibraryBots finished eleventh of twenty-three robotic teams. Middle and high school teams from across Virginia were present but the LibraryBots represented the first and only public library-sponsored team in the competition. With grants from VAFirst and Rockwell Automation, CCPL founded the LibraryBots. This robotics team is free and open to all Chesterfield County middle and high school public, private and homeschooled students who have an interest in robotics and STEM (Science, Technology, Engineering and Mathematics) practices. Library staff and professionals with backgrounds in the sciences and related STEM areas volunteer to mentor this rookie robotics team. Our sponsorship of the LibraryBots represents an innovative approach to bringing robotics and STEM education front and center in Chesterfield County. By learning alongside the students, CCPL staff members are becoming science, technology, engineering, and math-savvy as well. This program represents a prototype of a library's potential role in the community as a facilitator of learning and a venue for people to gain skills in a self-directed learning environment.

The Challenge: A Need for STEM Education

In May 2013 the National Science and Technology Council's Committee on STEM Education (CoSTEM) issued a status report and 5-year strategic plan restating President Barack Obama's intention to make the improvement of STEM education a priority in his second term. The plan highlights "the importance of STEM education to American scientific discovery and innovation, the need to better prepare students for today's jobs and those of the future, and the importance of a STEM-literate society." The need for STEM knowledge and skills is growing rapidly; however, according the ed.gov/stem website only 16 percent of American high school seniors are proficient in mathematics and interested in a STEM career. *100 Best Jobs of 2014*, by U.S. News & World Report states that half of the top 50 jobs are in STEM professions. Scholarships abound for college students pursuing degrees leading to jobs in STEM careers. Women and minorities are heavily recruited due to their low number in the science and mathematics professions.

In this slow economy, STEM job growth continues to climb. One of CoSTEM's five goals is to increase and sustain youth and public engagement in STEM. Students need exposure to a myriad of STEM activities and interests inside and outside the classroom to engage them in the learning style that is most successful for them personally. CCPL's mission is to transform information into usable knowledge, so we feel that to inspire learning in this crucial area is important to our mission. As a leading county institution offering learning opportunities, the public library can provide STEM programming for the entire community to supplement school curriculum.

A robotics team offers a unique, yet ideal, way to teach participants critical thinking skills essential to STEM education and careers. Robotics requires a conceptual understanding of math, science and engineering.

CCPL is in an excellent position to help students build needed STEM skills. Students visit the library after school, in the evening and on weekends. The CCPL LibraryBots team was an excellent way to engage staff and teens in a joint learning experience in a safe, community meeting place. Several of the students on this rookie team are homeschooled or are not able to participate in teams at their schools due to their parents' work schedules. Additionally, the library is popular with teen girls and CCPL has a large, active group of young women who regularly participate in our programs and check out our materials. By placing a STEM activity in the library it becomes accessible and non-threatening and non-competitive and associated with a place girls value. Even better, female staff members are creating and learning alongside them, modeling adult engagement in new technologies.

The Program: LibraryBots Team as a Prototype for STEM Learning

The LibraryBots were created in August 2013, to participate in VAFirst's 2013-2014 First Tech Challenge called FTC Block Party. VAFirst supports the international FIRST (For the Inspiration and Recognition of Science and Technology) program. The library had begun to investigate STEM opportunities in the community and became aware of the VAFirst program through members of Richmond's community makerspace, called Hack RVA.

FIRST is a non-profit organization that was created to excite young people about science and technology, prepare today's students to enter the advanced technology-based workplace of tomorrow, and provide them with life skills that will prove valuable in the future. The vision of VAFirst is to transform the culture into one in which science is an integral part of people's lives, which makes this organization an attractive partner for CCPL because we view our mission as transformative, as well.

Following the tenants of VAFirst, CCPL set out to provide an opportunity for teen library users to build a robot and compete in the 2013-2014 challenge. With a retired engineer, an experienced robotics high school student, a local businessman, parents and library staff as the team facilitators and mentors, the plans for a robotics team began to take shape. This team was open to everyone – boys, girls, home schooled students, public school students, or private school students. Robotic experience was not needed, just an interest and desire to learn. With flyers, an announcement on the library's website, and word of mouth, a list of interested students was created. Although VAFirst has four competition levels, from Junior Lego League projects through a full-sized robot with advanced programming, we selected the middle-school-aged level for our focus due to expressed interest when gathering comments at library programs and talking to customers. After initial informational sessions, the LibraryBots was established. Meeting twice a week, the mentors, library staff and students completed a class in small tool safety and began working as a coherent team to design, program, and build a robot.

From August 2013 through January 2014, team members built an 18-inch remote-controlled robot using a custom robotic platform created specifically for *FIRST* teams. During the season, teams document their progress with very detailed notes and sketches, keep an inventory and budget, raise funds, and volunteer in the community. The engineering log describes the process behind the creation and deployment of their robot and includes drafts of ideas that did not make it into the final design. Students learn CAD programming to create custom parts for the 3-D printer and in RobotC to program the robot to move autonomously at the appropriate stage of the competition and to respond correctly to handler's commands.

These real-world math and science skills will prepare teens for future educational and career opportunities and increase their qualification for numerous scholarship programs dedicated to these fields. VAFirst encourages what they call gracious professionalism, so the technological skills are enhanced by the attention paid to cooperation, organization, and teamwork. At scrimmages, students are encouraged to network with those on other teams, even to build "alliances," where they can learn from other students and begin to recognize the value of partnerships and community. After competing at the local level, teams can earn a place in the State and World Championships. At all levels, teams compete for several awards in areas that include engineering, design excellence, and sportsmanship.

Costs for the program included competition entry fees, materials, and staff time.

- Competition entry fees ranging from $100-$300 per event
- Starter kit, offset by a $875 VAFirst grant for rookie teams and a $275 Rockwell grant
- Extra parts, filament for 3D printer, tools, t-shirts, transportation. The cost varies depending on offset by having team members find alternative funding or donate or lend tools and supplies. Cardboard boxes were used extensively for prototyping.
- CCPL provides staff hours for oversight, guidance, mentoring, and training.

Results of the Program: A Successful Technology Learning Experience

The LibraryBots team started with thirteen to fifteen teenagers and averaged eleven attendees at the twice-weekly meetings. None of the participants knew each other before the program, but the team jelled nicely and worked well together. While the team's primary focus is STEM practices and learning, the peripheral requirements for teamwork, presentation, socialization and responsibility contributed to the notable success in meeting CCPL's objectives of providing opportunities to apply STEM practices

that positively impact life skills. Working as a group, the team used technology skills to build a robot for the Virginia First competition. Students used a wide variety of technology, including:

- MakerBot2 3D printer to solve build challenges
- Electronics, such as wires, circuits, arduinos, batteries
- Hardware, such as repurposed toughbooks (PCs) from Chesterfield's IST Department that had been used in police vehicles, sensors, joysticks, cameras, t-bars, plexiglass, wheels
- Miscellaneous small hand tools, Legos, safety glasses and other protection, foam for a bumper
- Software, such as CAD and RobotC
- Websites: www.thingiverse.com, www.virginiafirst.org/first-programs/ftchome, www.autodesk.com

At the First Tech Challenge (FTC) Central Virginia Qualifier at St. Christopher's School, in Richmond, Virginia, on December 7th, 2013, LibraryBots finished eleventh of twenty-three robotic teams. The LibraryBots team received positive comments by the judges on its engineering log and on the students' enthusiasm and professionalism. The team completed its first season and look forward to next year's challenges.

In addition to competitions in Virginia, team members have presented their work to Chesterfield County officials, including members of the School Board and the Board of Supervisors. Proudly wearing their LibraryBots logo t-shirts, team members demonstrated their robot and enthused about the experience they had had at their public library. CCPL staff members have also been able to apply new skills when thinking about public service and community partnerships. The program has provided networking opportunities and the development of potential STEM-based offerings for new

groups of library users. Prototyping a model, small business use, 3D printing for students, hobbyists and professionals are only a few of the products and services to be explored.

The CCPL LibraryBots team is the first and only library-sponsored robotics team in Virginia, and as such is a benchmark for similar services among communities looking for new ways to provide STEM opportunities in their communities. Chesterfield County employees have vastly increased their knowledge of applied technologies and programming and have had the opportunity to form partnerships with community groups such as Hack RVA and the Friends of the Library. This innovative program supports the STEM efforts and goals of Chesterfield County Public Schools and of the entire community. By using a new approach to self-directed STEM learning in a three dimensional and hands - on collaborative learning environment, CCPL and the LibraryBots team have made strides towards the library's goal of transforming information into knowledge.