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Bringing Science to the Children: Cooperation between Academic and Public Libraries

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Abstract:

This paper offers two cases of public libraries providing science, technology, engineering, and mathematics (STEM) programs for children. These programs are designed to increase enthusiasm and achievement in the sciences. The importance of increasing enthusiasm and achievement in STEM is a well-documented need in the literature, with examples of how public and academic libraries each can serve a role via programming. Examples of them collaborating for such programming are sparser. Public libraries often lack staff subject expertise in STEM and colleges and universities often lack the day-to-day access to children. On the other hand, public libraries do have the day-to-day access to children, while colleges and universities have expertise in STEM and access to STEM researchers. Academic librarians can serve as bridges between their school and their public librarian colleagues. This combined expertise shows promise for collaboration for STEM programming targeting children. While public and academic libraries collaborate for collection and even space management, successful programming collaborations are not as evident. With thoughtful public/academic collaboration, both librarian types can work together to provide quality programs targeting children that aim to make STEM more inviting and relatable.

Keywords: public libraries, academic libraries, children, programming, science

Introduction

Programs at libraries need not be implemented in isolation. In order to provide effective STEM programming with positive outcomes, librarians should consider collaborating with STEM-related organizations and professionals in order to produce quality programming for constituents. This can even include different library types (public, academic, school, government, etc.) collaborating in order to leverage expertise and resources to produce quality programs that are of mutual interest. The authors tracked two programs in the state of Ohio, USA which leveraged expertise in order to produce quality programs for children (ages up to 17) related to science, technology, engineering, and mathematics (STEM). One innovative program involved the Cleveland Public Library (CPL) reaching out to the Cleveland Municipal School District (CMSD), Case Western Reserve University (CWRU) and The Ohio State University (OSU) Extension to produce a program to increase enthusiasm for and achievement in STEM for older children (7^{th} – 12^{th} grades). The other is an established program from OSU reaching out to Worthington Libraries (WL) to reach an audience of younger children (typically preschool and elementary) during summer to increase exposure and enthusiasm for STEM.

Literature Review

Academic and Public Library Collaborations

Research shows substantial cooperative ventures between academic and public libraries. These include sharing collections and even spaces. However, cooperation related to programming, especially in STEM, is much sparser.

Van Den Hoogen and Parrott (2012: p. 321) conclude that enhancing library services via a borrowing network of multiple library types, is a cost-effective means of meeting library client needs. Perhaps a unique example which proved popular, despite challenges, is an academic and public library cooperating to provide an automated machine for pickup of public library materials on a college campus using a smart locker (Jayroe, 2015: 36).

Sarjeant-Jenkins and Walker (2014: p 449) address advantages and challenges related to creating partnerships between different library types. Noted advantages include sharing expertise and ideas, offering additional services, and raising awareness of programs and services. A challenge includes resources, including time, space, and money, that have to be invested. The authors also indicate the importance of respect for what the different partners can provide and the willingness to take risk.

Some libraries have attempted programming atypical of their library type. For example, Tvaruzka (2009: 21) describes an academic library's children's story time. While a formal collaboration with a public library was not present in this case, Tvaruzka suggests public library story time observation and non-competing time slot consultations as good things to consider for those interested in such programming.

Programming partnerships can increase and benefit all partners involved. Knipp et al. (2015: 73) found collaborating on events related to comics and anime led to increased visibility for both institutions involved. Another programming collaboration involved academics and public library users addressing early childhood literacy (Lucas, 2013: 197).

Todaro (2005: 144-5) lists some benefits of collaborations to libraries, including access to an additional customer base; wider visibility of services/activities; gaining new skills; gains in expertise; and also energize staff with new activities. Additionally, colleges and universities can expand beyond the campus. "Outreach K-12 or K-16 responsibilities are being articulated by colleges and universities and articulations include assigning outreach to specific departments or individuals and/or hiring someone to coordinate or complete those responsibilities" (Todaro 2005: 139). Todaro (2005: 143) also gives examples of considerations at the start of new relationships and adapting to change.

An example of academic-public library collaboration in Ohio includes circulating materials across Ohio via OhioLINK and SearchOhio. More close relationship examples include collaborations in the Cleveland area with CPL and Cuyahoga County Public Library to provide popular reading materials to area colleges and universities, including some satellite locations at academic libraries (Overfield and Roy, 4-6).

While there is not much evidence in the literature about STEM programming done cooperatively by academic and public libraries, the evidence of other types of collaboration, primarily related to collections, spaces, and services with a few mentions of other types of programming, point to the ability and value of public and academic librarians collaborating.

STEM Centered Enrichment Programs - Schools & Scientists

The National Science Board (2010) issued its *Science and Engineering Indicators 2010* document, which covers a wide range of issues related to educating children in the sciences. The following findings which point at the value of STEM programs, especially those involving scientists, for children:

- Teachers who teach elementary-aged, and in many cases middle-school aged, children mathematics and science, usually do not have degrees in those disciplines (1-4, 1-25).
- For households with a Bachelor degree or higher, students were more likely to be taught advanced science and mathematics skills in the 8th grade or higher (1-5).
- Low-income or low-achieving students are less often taught science or mathematics in eighth grade by teachers with an advanced or science/mathematics degree (1-5).
- Students who completed advanced science and mathematics courses in high school were more likely to go to college and less likely to need remediation there (1-6).
- The U.S. is outperformed on science/mathematics tests by several countries. Low-achievers, Black and Hispanic students tend to have lower scores on science/mathematics standardized tests (1-8 – 1-24).
- More concentrations on the STEM areas are in high demand, "with total employment in occupations that NSF classifies as S&E will increase at more than double the overall growth rate for all occupations" (3-14).

Harris (2015: 5-6) indicates that some librarians are trying to maintain relevant programming, preferably in the STEM areas, for children. Libraries are now realizing the importance of promoting science literacy, supporting a deeper understanding for better preparedness for future generations.

Most enriched programs that target or support the STEM areas most often focus on middle school or high school areas to promote the sciences, often leaving the elementary students out of the development (Vasquez, 2005: 10; Yasar et al, 2006: 211). Early exposure to STEM areas helps students develop a familiarity with STEM and these important concepts. Shanahan and Nieswandt (2009: 131-2) describe a Canadian program where hundreds of thousands of elementary-school aged children were reached by scientists in order to improve enthusiasm for science.

The College of William and Mary, working with area schools, collaborated to promote a summer program for STEM and other interests with gifted youth, taught by college faculty and area teachers (Peterson et al., 1992: 3-4). Another program involves a network of ecological research sites pairing scientists working on a study with teachers in order to give their students (5^{th} grade in this case) a "citizen science" experience with scientific research (Bennett, 2010: 50).

Other countries are showing programs of STEM hands-on activities led by academic scientists. Such outreach activities are producing fast-paced interest in STEM, especially if exposed from early ages. As part of "The Blue Marble" project, the Universities of Leicester and Nottingham (United Kingdom) scientists developed day-long, interdisciplinary, hands-on workshops for primary schools to introduce space technology and the role of the research scientist (Muller et al., 2013: 176).

Clearly, STEM programs, especially those involving scientists, are valuable supplements to students' education. They have successful ways of instilling in children an appreciation and understanding of achievement in STEM areas.

Value of Collaboration

While there is definite value in STEM programming at public libraries, connecting children to scientists can be a challenge. While colleges/universities have scientists, attracting children to come to campus can prove difficult. This provides the opportunity for possible collaboration. Both public libraries and colleges/universities have goals for educating (and many colleges/universities have working with the general public also as part of their mission). Academic librarians can serve as bridges between scientists, with whom they work on a regular basis, and public librarians, with whom they have other types of relationships (collections, services, and spaces). Academic librarians and many college/university scientists do not, however, regularly work with large groups of children and may also have trouble dealing with marketing. Thus, they may be hard-pressed getting children to programming. This is where the expertise of public librarians comes in.

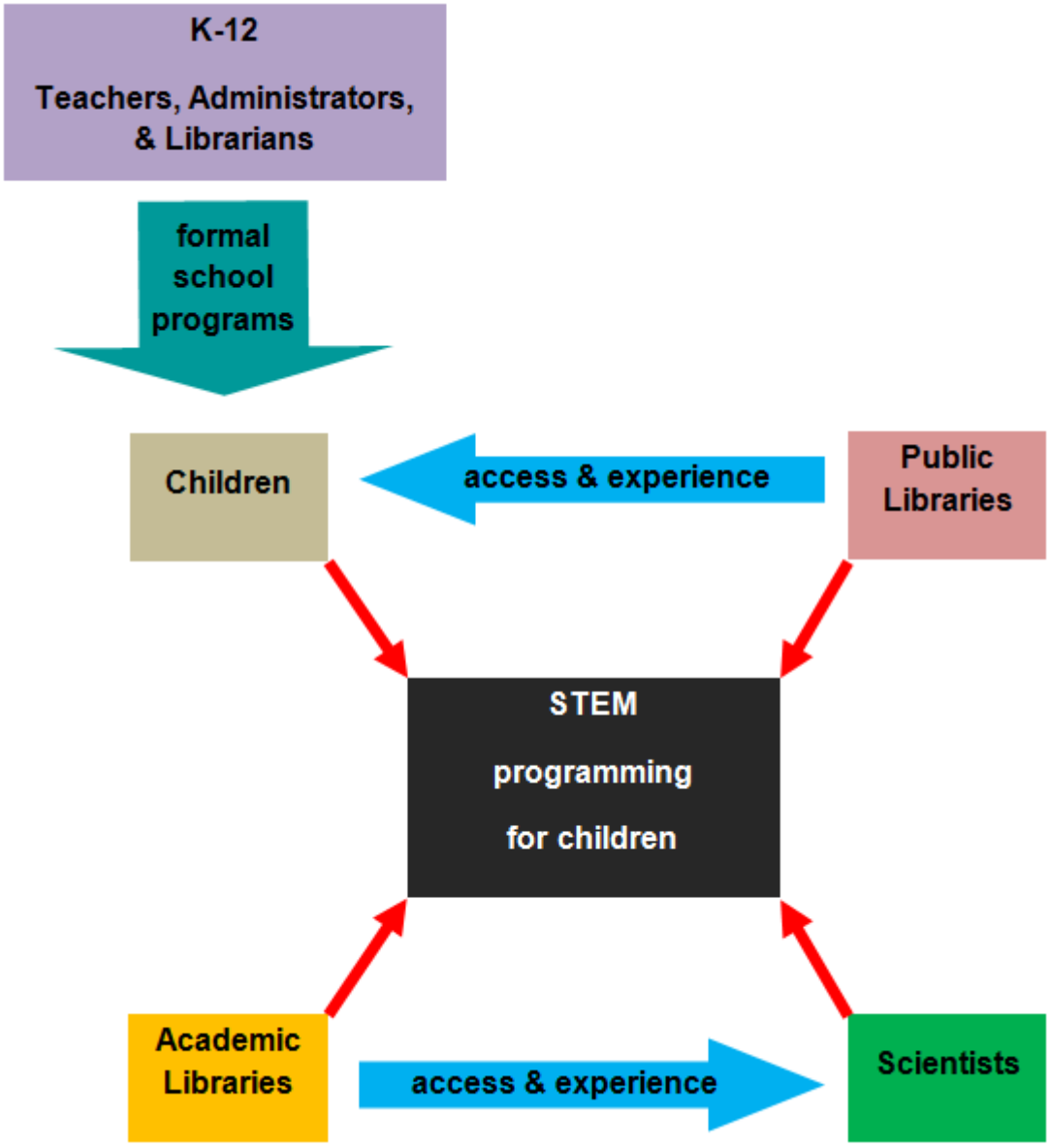

Figure 1: Relationships Leading to STEM Programming

The missions/visions of the organizations involved in the two programs this paper describes contain terms related to concepts such as education, collaboration and community. These common terms in mission/vision point to common goals and thus potential for collaboration.

Cleveland Public Library	The Ohio State University	The Ohio State University Extension
"We are 'The People's University' a center for learning for a diverse and inclusive community" (Cleveland Public Library, 2013).	The Ohio State University (2016) indicates that "We exist to advance the well-being of the people of Ohio and the global community through the creation and dissemination of knowledge" and three of its four goals are Teaching and Learning, Research and Innovation, and Outreach and Engagement.	The Ohio State University Extension (2016) states how its mission by "engaging people to strengthen their lives and communities through research-based educational programming."
Cleveland Metropolitan School District	**Worthington Libraries**	**Case Western Reserve University**
The Cleveland Metropolitan School District (2016) indicates it will "produce graduates prepared to assume leadership roles as students in colleges and universities, as professions in their chosen careers and as citizens in a global society."	"Worthington Libraries connect people to a world of ideas and each other" and one of the five core values is "Collaboration: We share our talents and build partnerships to strengthen the community" (Worthington Libraries, 2016).	Case Western Reserve University (2011) states it "improves and enriches people's lives through research that capitalizes on the power of collaboration, and education that dramatically engages our students"

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Figure 2: Common Goals in Missions & Visions

The Cleveland Public Library's Mean Green Science Machine Experience

Today, the "Cleveland Public Library circulates one of the largest and most extensive collections in the country boasting close to 10 million items" (Cleveland Public Library, 2013). The Cleveland Public Library (CPL), an urban library system with 28 branches, serves the city of Cleveland, with a population of nearly 400,000 with a median income of $26,179 and has a diverse population, with 62.7% of the people living in the city being non-white (United States Census Bureau 2010-2014). CPL awarded an Innovative Grant to a project called the *Mean Green Science Machine: We Run on Community Energy (MGSM)*. The project provided for the collaboration between Cleveland Public Library (CPL), Case Western Reserve University (CWRU) and Ohio State University (OSU) Extension via lab experiments, field trips and exposure to local scientists. The results were sustainability workshops for youth in the 7^{th} – 12^{th} grade in Cleveland area schools. The MGSM is a science-literacy based program that promotes and enhances educational areas in STEM. The program provided the community with the tools to lead in the 21^{st} century and beyond. MGSM offered a look at employable, sustainable opportunities for children and youth in Cleveland. This program bridged the digital, agricultural and technological divide to an urban community at CPL.

Kathryn Sullivan, director of the Battelle Center for Mathematics and Science Education Policy at OSU, made a personal plea to focus on the middle school years in science education. According to Sullivan, these years represent, "the sweet spot;" that is, those years when

children decide whether they are good at science and start making choices accordingly. She called for institutions to coordinate efforts to impact the preparation and skills of children (Rapporteur, 2009: 7). Not only did MGSM impact the children who participated in it, the program was also an investment in the future of the next science literate generations to come.

According to the Ohio Department of Education (2014-2015), CMSD has the following attributes:

- 39.3% of graduates entered college within 2 years.
- 66.1% of high school students graduate within 4 years.
- CMSD received a failing grade for student passing levels on standardized tests, including mathematics and science.
- 60% of students are at a Basic or Limited Achievement Level.

Ninety middle and high school students from CMSD were selected by their principals, teachers, and school librarians to participate in this STEM-centered program which evolved into a Lab-on-Wheels. Students were selected based on the following: (1) their parents were active in their education; and, (2) the students had a C or better grade point average. Recruitment via recommendation helped to weed out students with behavioral problems so the scientists could focus on science.

It is important to provide a more in-depth focus on each participating institution in order to help the audience carefully select organizations in the future. They will want to consider those organizations and scientists who will most benefit the program and leave students feeling excited, encouraged, and empowered to follow a path in a STEM education and career.

With the CPL Innovation Grant in hand, and with approval from CMSD and OSU Extension, the CWRU Department of Physics faculty were more than eager to share science with an urban population of young people.

Lab-on-Wheels Activities with local scientists at The Cleveland Public Library

- Students investigated energy (including solar and wind), its usage, pros and cons, new and old ideas, and the concept of using alternative sources to harness energy.
- Students learned about soil pH.
- Students learned microbiology through the process of making ricotta cheese; students were able to replicate the process at home.
- Students experimented with the process of growing local foods; students took home a lettuce garden and apples.
- Students learned the difference between carbohydrates and sugars in local foods.

Lessons learned:

1. First, establish a roundtable to include a public librarian, an academic librarian, and/or a special (i.e., STEM) librarian – to discuss the project overview and invite input for additional options and other collaboration opportunities.

2. Consider local higher education institutions of all types, including public and private and two-year, four-year, and research institutions as possible collaborators.

3. Alert staff prior to possible loud sounds on program days.

4. Be ready to explain to other young library users why they cannot participate in the program.

5. Contact local grocery stores for donations of water and/or snacks.

6. Graduate students from CWRU were able to facilitate experiments with the children, while learning how to communicate with a younger audience using science vocabulary.

The Ohio State University – Worthington Libraries Science Café Experience

OSU's main Columbus, Ohio campus is a large land-grant research university with over 10,000 graduate students and over 3900 regular clinical and tenure track faculty (The Ohio State University 2015).

Worthington Libraries (WL) is a suburban public library system with three locations serving a diverse group of over 90,000 borrowers (more than the Worthington population). WL's 150 employees plan more than 1,000 programs a year.

Recent changes have challenged Worthington's formerly affluent demographics. In January 2012, 25% of students (up from 5% a decade ago) were enrolled in the free and reduced lunch program (Candisky, 2012). One elementary school indicates that their racially diverse student population sees a 15 to 25% transience rate, about 50% qualification for free or reduced price lunches, and in total speak 20 languages (Seven Years at Slate Hill, 2010). The Worthington food pantry served 1,200 families, logged 400 - 500 visitors each month as of April 2016 – up 27% from the year before (Candisky, 2016).

Since April 2008, the OSU Libraries, in conjunction with the OSU chapter of the scientific honor society Sigma Xi, has held a series of scientific talks open to the public on a wide range of scientific topics (see http://go.osu.edu/scicafespeakers for past topics and speakers) in its OSU Science Café. Most presenters are employed by OSU, which is a ready source for faculty and students in its many science (including physical, life, and mathematical sciences), engineering, and medicine (including veterinary medicine) disciplines. This access to scientists, and thus potential speakers, is great for bringing people together to hear about and discuss scientific issues.

During fall and spring semesters, faculty and students fill the campus, allowing for a ready source as an audience, although non-OSU community members are encouraged to attend. Some previous topics (e.g. bed bugs, coyotes, Dr. Who) have even lent themselves to an increased attendance, especially from outside OSU. Summer is a much quieter time on campus and so seemed a good opportunity to focus on programming for children, who are out of school. A few years of trying a variety of speakers and locations garnered only small audiences (many related to OSU employees), with twenty or so children being the maximum attendance.

After a few years of trying to get children to come to campus, the decision was made that OSU Science Café should go to the children. Touching base with one of the WL librarians, a trial at getting OSU's Science Café to be hosted during their summer programming was suggested and accepted.

This mutually beneficial relationship seemed perfect. OSU has ready access to scientists. WL has access to children. While attendance at children-focused Science Cafes on campus was successful in that children did attend, the attendance was not exactly what one might call "a crowd." Worthington Libraries could pack a room. Groups as much as five times the size of OSU's best attempts were seen. Three speakers have become favorites and are regularly invited back. These speakers cover topics related to animals found in the wild, chemistry, and physics. Two work for OSU and the third is a scientist related to an OSU faculty member. Having started at one WL location, the Science Café worked its way up to visiting all three locations each summer.

When the Science Café started, WL did not really know what to expect. In the past, they hired science presenters like the "Turtle Lady" and they had worked to produce their own STEM-based programming, but they were not sure if this partnership would meet its needs. The first program was such a success that when it came time the next year they were happy to add more Science Cafes to their summer programming calendar. Initially, the programs were only presented at the Northwest branch because the original WL contact worked there. As the program progressed, discussion came up at the systems planning meetings about extending the program offerings to the Old Worthington library as well. At the time it was expanded to Old Worthington, WL's third Worthington Park branch was under construction and would soon have a meeting room to host programs like this. In 2015 Worthington Park requested a Science Café to be added to their summer schedule.

OSU's facilities are set up primarily for adults, not children. Hosting events at a large urban university results in hassles with parking and walking with children from garages. Adult-sized tables and chairs are in its spaces. Accessibility to the general public is what public libraries are all about. Parking is available and one of the locations is easily accessible via Columbus's city buses. WL's facilities were designed with children in mind. Meeting rooms are even set up for crowd control, with markings on the floor for keeping children in place and allowing for pathways as they sit on the floor to watch events. One of the locations has an outdoor area that is perfect for our messiest and loudest regular presenter – which enables the children to spread out even more. The youth services staff at Worthington are also trained and experienced in crowd control of this sort. They work with a variety of young patrons each day and are prepared to manage the different needs, whether physical or developmental, that each of their patrons may bring to the program. They could help not only with normal safety and

comfort measures (making room for many bathroom runs and having chairs for adults or children who could not sit on the floor), but they could also help organize the crowd for the performer who may want to pass an item around or solicit volunteers while keeping the rest of the room safe and under control. They also understand how to work both with children who do not have an adult accompanying them and how to handle adults that come to participate in these programs with their children.

For the three years 2013-2015, a total of 28 science cafes were held, with seven of them being held at Worthington Libraries, targeting children. OSU Science Cafe's attendance for 2013-2015 has seen all of the attendance figures for the children-focused cafes at WL being over 50 attendees, while only three of the regular cafes having attendance at 50 or more (these were popular topics that got community visitors: climate change, solving crime using anthropology, and the science of Dr. Who). One of the early conversations we had was about the fact that WL handed out free tickets to large programs to stay within maximum capacity guidelines. This illustrates the value of collaboration and the interest in events targeting children.

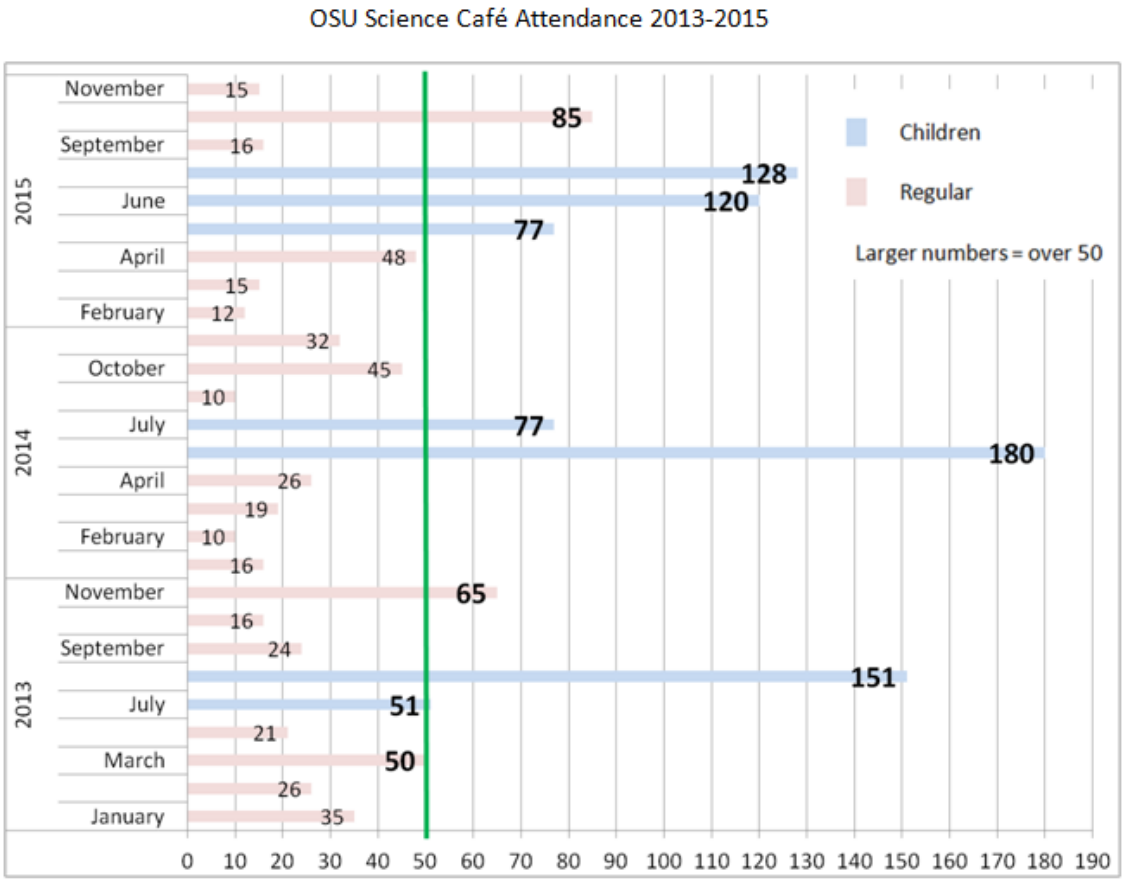

Figure 3: OSU Science Café Attendance 2013-2015

Twelve OSU Science Café events were held at WL from 2010-2015. Attendance has always been at least twice as much as the best efforts of getting children to come to the science cafes on the OSU campus.

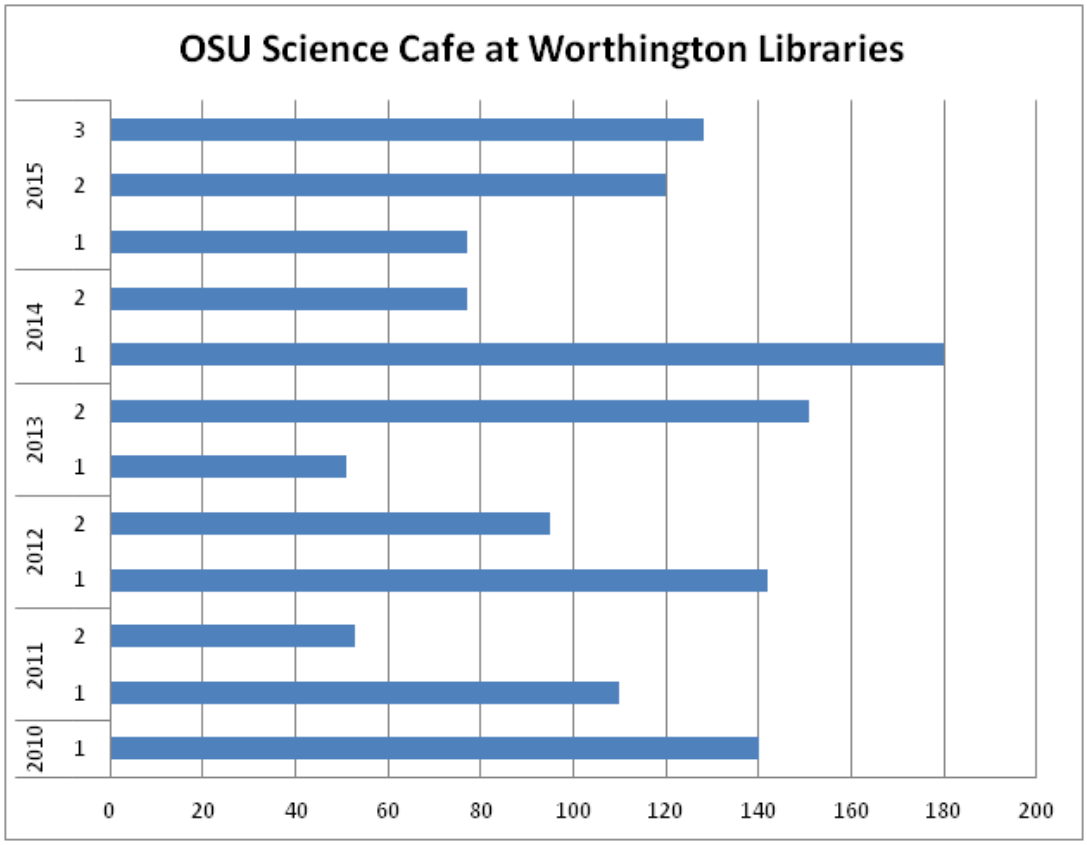

Figure 4: OSU Science Café at Worthington Libraries

One consideration to make when examining participation at WL was that each of these was held during their Summer Reading Program. School year programs on average do not have the same high numbers of participants as seen in summer. Advertisement is through normal WL routes, but also via flyers highlighting programs sent home via Worthington School District. They are also paired with other high interest programs such as musicians, jugglers and magicians. All of this planning helps the library increase the numbers of participants that will attend a Science Café.

Lessons Learned

1. Crowd favorites proved to be those involving animals or loud, flashy, and/or messy chemistry/physics related events.
2. Speakers should expect children to provide unrelated comments/questions, make noise, and some children will expect explosions as a potential result.
3. While one location has an outside venue, weather may require a move inside and the need for presenters to make adaptions.
4. It is important to have frank discussions about meeting the needs of both organizations. One advantage was that the original two point people knew each other in advance. This made discussions about issues that arise, e.g. speaker presentation style, model rockets landing on a neighbor's roof, etc., easier.

5. We also learned we work at different speeds. WL requires much more notice in order to get its summer programming in order. Duplication of an existing topic may require a change. With this advanced notice, one regular speaker is willing to adapt to WL's summer reading theme.
6. WL's coordinator has changed hands (no longer based upon a personal contact), but the program has continued to grow and flourish with others taking it on.

Conclusions

The two programs presented indicate that libraries can serve an important role in encouraging children's interest in and improvement of skills related to STEM. The skills and resources within a single organization are not always enough to accomplish such quality programming. By reaching out to expertise and resources available at other organizations, these combined efforts can accomplish a much better program. Public libraries know children. Colleges and universities know science. Academic librarians are in an ideal position to serve as a bridge between public libraries and STEM researchers on their campus. They know their campus and are experienced with working with a wide range of campus departments and offices. Thus, they are able to identify the great resources and people on campus that may be missed by someone unfamiliar with campus. As demonstrated in these two experiences, there are great benefits when public libraries collaborate with other institutions, including schools at all levels and their libraries, to create STEM programming for children.

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