Engaging Children And Youth From Low-Income Communities In Science Learning

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A Final Report Prepared for the Council of Ontario Directors of Education

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Engaging Children and Youth from Low-Income Communities in Science Learning

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[1] Prairie Lane is a pseudonym used throughout this report.

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EXECUTIVE SUMMARY

The central purpose of this research was to examine ways in which educators can engage children and youth from low-income communities with informal (out-of-school) science learning. The specific objective of the study was to gain community input about how the community's own children can be encouraged to maintain their engagement with science and science education. The project described in this report was a collaborative endeavor, conducted by a University of Toronto research team in collaboration with the not-for-profit organization Visions of Science Network for Learning.[2] The strategy we employed was to examine the practices of an existing, highly reputable informal science education program that serves low-income communities (Visions of Science's STEM Club program), combining insights from leaders and children participating in the clubs with those of community members and teachers in a proposed new science club location. After examining the best practice strategies and recommendations of these various stakeholders, we co-designed the parameters for a new science club.[3] The new club was located in a low-income area that previously had little or no free informal science programming for children: the Prairie Lane neighborhood in the Rexdale district of North Etobicoke, Toronto. Our focus for the new club was to be intentional about responding to community-expressed needs and interests so that the children's informal science educational experiences could be as integrated into their broader community life as possible and vice versa. The club priorities included: developing connections to place-based science; providing opportunities for children to investigate areas of science that personally interest them; exploring community 'funds of knowledge' and research on community-responsive initiatives; and developing personalized extensions to existing activity protocols. During the implementation of the new club we explored the feasibility and efficacy of the various plans we had put in place. This report summarizes the implementation phase of the research.[4]

The new Community STEM Club was located at Prairie Lane Junior Public School as an after-school program on Monday evenings for children in Grades 3 to 5.[5] A member of the research team served as a volunteer staffer in the club throughout the academic year. Having established a set of priorities for the club, we used qualitative research approaches to explore challenges and opportunities presented by this experimental context. Our research strategies included: holding introductory interviews with children attending the club; conducting post-club focus groups with club attendees and individual interviews with club staffers; interviewing the principal and school teachers about the impact of the club on the school community; and keeping detailed, ongoing field notes regarding club sessions and club-related events.

According to accounts given by all community members, the club was a resounding success. Although most children joined the club because of personal interest in science, adults in their lives were able to detail so many ways in which the children had grown over the year. The complementary interaction of formal and informal science educational contexts was incredibly supportive to the children's academic and person/social development. A significant highlight of the club year was the showcase event to which children's peers, teachers,

[2] The organization is officially registered as Visions of Science Network for Learning; it is commonly known as Visions of Science and will be referred to as such for the remainder of this report.

[3] Although the focus of this research is on the science aspect of the club context, all Visions of Science community clubs are known as STEM Clubs (focusing on science, technology, engineering, and mathematics) so STEM and science terminology are used interchangeably in this report.

[4] This report is a supplement to the interim report: Burke, L. E. C., & Navas Iannini, A. M. (2018). *Engaging children and youth from low-income communities in science learning: An interim report prepared for the Council of Ontario Directors of Education*. Unpublished report. Department of Curriculum, Teaching and Learning, Ontario Institute for Studies in Education, University of Toronto, Toronto, Canada.

[5] Prairie Lane is a pseudonym.

and family members were invited. The gains from this club setting were greater than anticipated for the school, the children attending, their families, and the Visions of Science organization. The findings detailed in this report indicate that there is much potential to develop this model of community science club programming in other contexts.

This summary document ends with a model identifying key features of community-responsive science programming, as identified in this study. Suggestions are made to indicate how the work started in this study could be further developed by Visions of Science and other organizations whose passion and drive is to work within community settings to address science education inequities that exist for children in low-income communities.

OVERVIEW OF THE STUDY

The central purpose of this research study was to examine how children's engagement with science education can be fostered in low-income communities. The study's methodology acknowledged the connection between informal science education and pursuit of science-related career routes.[6] Although the study was not centered on generating future members of the science, technology, engineering and mathematics (STEM) workforce, the research team joined Visions of Science in their aspiration to keep children's options open for as long as possible with regard to science education. In addition, we see value in supporting children as they take their places as informed citizens, capable of contributing to scientific debate and science-related decision-making in their own social contexts. In our study design, we recognized that engagement with informal opportunities for science learning involves a complex interaction of multiple factors, rather than being a simple matter of economics or geography; hence, our attention was set on broader aspects of a child's relationship with science within their community.[7] This perspective has resulted in us focusing on the interconnection of multiple educational sites within a child's community that contribute to a child's engagement with science. Figure 1 illustrates our conceptualization of the interaction of various formal and informal locations of science learning for the child. We note that, while the extent of the influence exerted by each component may vary from child to child, any component can serve as a driver for the child's science engagement.

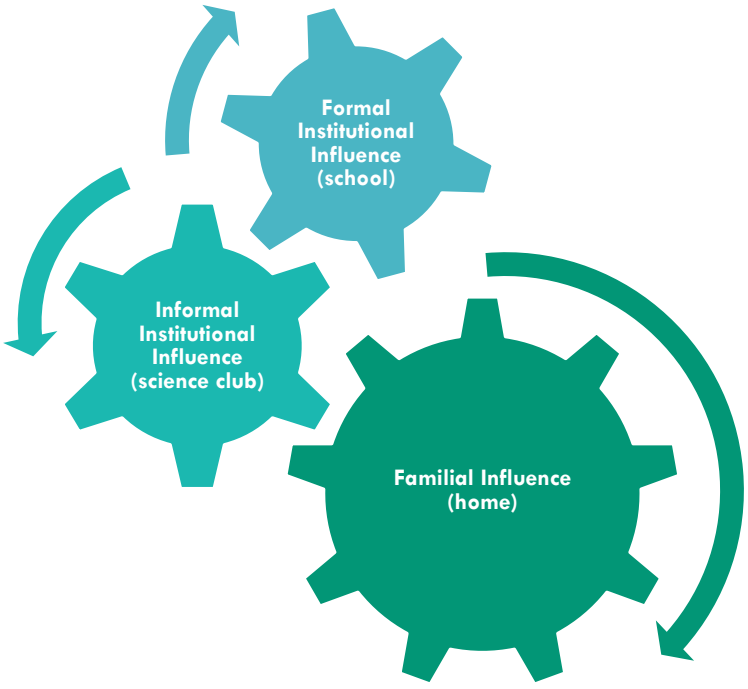

Figure 1. A community perspective of the elements contributing to a child's engagement with science education. The informal institutional influence of concern in this study is the science club context.

[6] Dorsen, J., Carlson, B., & Goodyear, L. (2006). *Connecting informal STEM experiences to career choices: Identifying the pathway*. ITEST Learning Resource Center. Retrieved from http://stelar.edc.org/sites/stelar.edc.org/files/itestliteraturereview06.pdf

[7] Dawson, E. (2014). Reframing social exclusion from science communication: Moving away from 'barriers' towards a more complex perspective. *Journal of Science Communication, 13*(2), 1-5.

Our research was conducted in two phases. During Phase 1 (September 2017 to August 2018), background research was conducted to examine best practice and recommendations of existing and proposed new community members. Phase 2 of the study (September 2018 to August 2019) involved establishing and maintaining a new experimental club to run weekly during the academic year. This report reflects on the challenges and triumphs of the strategies employed. Details of the two phases of this research are briefly summarized below. Further details of Phase 1 are described in the study's interim report.[8]

Summary of Research Phase 1: Examining best practice

The research questions examined during Phase 1 of the study emphasized the community-based aspect of informal science education by asking i) What do participants identify as the current strengths and challenges of the Community STEM Club experience? And ii) What recommendations do participants suggest for developing a new community-based STEM club in a selected low-income area? The research strategies employed to address these questions included: conducting surveys with children across 21 Visions of Science STEM Clubs; carrying out focus group interviews in 14 STEM Clubs; conducting interviews with 9 STEM Club Staffers; holding a focus group session with teachers in a new community location; and documenting field notes based on a range of community interactions associated with promotion of the new STEM Club.

Based on analysis of these multiple data sources, we identified many strengths in the ways in which Visions of Science Community STEM Clubs are made accessible to and cater for children and youth in their home neighborhoods. In our recommendations for the new STEM Club, we focused on exploring how clubs can strive for greater community-responsiveness (see Figure 2). The various strategies that served as focal points for the new club are summarized below:

1. **Exploring collaborations with other community organizations**
   Making connections with other community organizations that might be significant in the lives of the children (e.g., schools, libraries, and volunteer conservation organizations); through these connections, STEM Club staffers might be able to connect activities with places and people that are already meaningful in the children's lives.
2. **Recognizing and working with community 'funds of knowledge'**[9]
   Emphasizing the skills, experience and wisdom of community members (including children, parents, teachers, and other community leaders) to which children are exposed in their everyday lives. This information can be used as one of the components informing club program planning.

[8] Burke, L. E. C., & Navas Iannini, A. M. (2018). *Engaging children and youth from low-income communities in science learning: An interim report prepared for the Council of Ontario Directors of Education.* Unpublished report. Department of Curriculum, Teaching and Learning, Ontario Institute for Studies in Education, University of Toronto, Toronto, Canada.

[9] We specifically refer to definitions of funds of knowledge emerging from the work of Vélez-Ibáñez, e.g., Vélez-Ibáñez, C. G. (1988). Networks of exchange among Mexicans in the US and Mexico: Local level mediating responses to national and international transformations. *Urban Anthropology and Studies of Cultural Systems and World Economic Development, 17*(1), 27-51. We specifically embrace this framework in an attempt to counter the discourse of deficit that is often associated with members of low-income neighborhoods. This framework has been used extensively by Luis Moll who defines funds of knowledge as "the knowledge base generated by families on the basis of their experiences, especially their work experiences, their social practices and social history": Moll, L. [usgovACF]. (2015, May 12). *Funds of knowledge* [Video file]. Retrieved from https://www.youtube.com/watch?v=aWS0YBpGkkE

3. **Incorporating contemporary approaches to science education**
   Infusing some of the more recent, research-informed approaches to science education that might be relevant to participant perspectives, such as place-based strategies that work to develop science literacy, scientific citizenship, and/or science for action.
4. **Exposing club leaders to primary research in science education**
   Incorporating into club planning and development, opportunities for exposing leaders and volunteers to literature associated with community-building (e.g., funds of knowledge and community-based and community-responsive education in relation to science education); these literatures were introduced in the study's interim report.
5. **Exploring the diversity of children's interests**
   Planning ways of managing the personal choices of children and diversity of their interests within the club setting; this includes, but is not confined to, providing opportunities for small-group extended inquiry.
6. **Supporting activities within and for the local community**
   Encouraging the club-based science exploration to expand into the local community, providing opportunities for local community members to participate in club-style science education; this might include, but is not limited to, having a mini-Expo (science fair) experience or family club days where locals, such as family members, are invited.
7. **Being explicit about the place of STEM terminology**
   Positioning science/STEM in relation to the club context; how fundamental is the STEM emphasis in the aims and goals of the club, and in what ways are these goals made relevant to the low-income context of children attending the clubs?

Figure 2. Shifting emphasis from community-located to community-responsive science club programming.

Strategy for Phase 2: Implementation of a new science club model

In collaboration with Visions of Science, we determined that the new STEM Club would present an opportunity to maintain areas of community-responsiveness that emerged as priorities in Phase 1 of the study, while exploring new modes of working with children in low-income settings. Having agreed on the Rexdale district as a suitable location for a new club (i.e., identified as low-income and having very few sustained informal science educational opportunities for children and youth), we set about establishing the parameters for the new club situation. We saw the new club as an experimental space, allowing us to explore what was possible in terms of informal science programming for children. Proposed points of experimentation with the established Visions of Science Community STEM Club model are detailed below:[10]

i. Stretching the existing model developed *for* the community and *in* the community to include working *with* the community in program planning considerations; this involves being more explicit about gathering feedback about and acting upon priorities and interests of community members (which includes the children and youth who will attend the club as well as teachers and parents)
ii. Locating the club in a space that children can identify as safe and familiar but which is not directly linked to the child's housing situation; a school location would serve this purpose
iii. If a school space is selected, the age range of club attendees would likely be narrowed, depending on the age range accommodated by the particular school; so, it might be possible to give activities a more age-specific focus
iv. Scheduling the club to run right after school (rather than Saturday mornings) might present opportunities for more children to attend while providing parents with a safe and educational space to leave their children during the common 9 to 5 workday schedule (although we recognize that this workday routine is not the reality for many workers in contemporary Canadian society)
v. Accommodating a second club in the same area (Rexdale) that follows the usual club model might provide Visions of Science with a means of evaluating the experimental club according to their own priorities and provide an alternative STEM Club opportunity for children whose parents/guardians do not wish for them to participate in the research-based club
vi. Planning field trips that are local, to places that may be familiar to children but which children may not have explored scientifically (emphasizing the everyday nature of the field of science)
vii. Allowing space in the program schedule for children to conduct and pursue their own scientific interests in a sustained inquiry-based fashion
viii. Creating opportunities for parents/guardians and other community members (such as teachers and the children's peers) to learn about and provide feedback on club activities

[10] Where first-hand information was not obtained, insights about the STEM Club model were derived from the organization's recent article: Duodu, E., Noble, J., Yusuf, Y., Garay, C., & Bean, C. (2017). Understanding the delivery of a Canadian-based after-school STEM program: a case study. *International journal of STEM education*, *4*(20).

Due to organizational constraints and commitments, the following aspects of the Visions of Science STEM Club program were retained and remained consistent with other clubs:

i. Running 2-hour hands-on workshops on a weekly basis from October to April (a slightly truncated academic year)
ii. Capping club attendance at 20 children to facilitate group activities while allowing for personalized attention from club leaders during club activities
iii. Having workshops guided by program facilitators, supported by volunteers
iv. Utilizing curriculum modules developed by Visions of Science staff; program facilitators would initially select a variety of modules that seem to have been popular with children in other STEM Clubs
v. Emphasizing relationship-building, leadership, and social-emotional learning that are fundamental to the program's ethos

Parameters for the new STEM Club

After examining the guidelines above, the following details were agreed for the new STEM Club for the academic year 2018/2019. Prairie Lane Junior Public School was selected as the location for the new club as it was in the target area, the teachers and school principal had already expressed enthusiasm for the club and had participated in the earlier phase of the study, the school had a dedicated space to accommodate the club, and the school principal was willing to lend support for a permit application for the club to operate in a TDSB space. The school has fewer than 400 students, Grades JK to 5, which would mean that the club was open to children in Grades 3 to 5.

Visions of Science leaders were able to liaise directly with the school principal to determine that the club would run for 21 sessions from 5 November, 2018 to 29 April, 2019 after school on Mondays from 3:15 to 5:00 pm in a dedicated (unused) classroom. Two experienced Visions of Science Program Facilitators were assigned to work at the club. One member of the University of Toronto research team was inducted as a volunteer at Visions of Science and participated in the STEM Club training session run by Visions of Science in preparation for working at the Prairie Lane club. The role of the researcher was to participate in club facilitation, as would a regular volunteer, as directed by the Program Facilitators. In addition, the researcher was tasked with keeping a detailed written record (field notes) of the activities that occurred in each club session as a means of tracking data with regard to the club 'experiment'.

Initial plans made by Visions of Science leaders were to split the academic year into 2 'terms'. The first term, prior to the winter break, would serve as an introduction to each of the constituent domains of STEM (science, technology, engineering, and mathematics) using curriculum modules that Visions of Science staff had developed, used, and reported as successful in a range of club settings. The first term would end with a survey or poll of the children to start gauging their interests so that they could be incorporated into term 2. After the winter break, the plan was to alternate prescribed modules with children's own investigative interests, incorporating self-direction into the children's activities. The final session (29 April, 2019) was planned as a half-day, whole-school showcase event to which parents/guardians would be invited.

RESEARCH STRATEGY AND METHODS FOR RESEARCH PHASE 2: ESTABLISHING A NEW CLUB

Phase 2 of the research examined the opportunities and challenges of developing a community-responsive STEM Club in Rexdale. A range of research strategies were used to generate data in this implementation phase of the study. All data were collected in compliance with the research protocols reviewed and approved by the University of Toronto Research Ethics Board and the Toronto District School Board External Research Review Committee. Participant consent (and/or parent/guardian consent for child participants) was gained for all audio-recorded focus groups, and audio-recorded interviews. Other data are based on field notes written by the Principal Investigator or other members of the research team after various community interactions associated with the research or after club sessions. Each of the research strategies is described in detail below.

Children's introductory statement sorting interviews

Of the 20 children enrolled in the club, 14 provided parental consent to be interviewed during term 1 of the 2018/2019 academic year (and a few at the start of term 2) to gauge their initial level of interest in science and explore the factors influencing their motivation to attend the club. Each interview took place just outside the regular club classroom, was between 10 and 20 minutes long, and was audio-recorded. At the outset of the interview, participants were asked some general questions about their interest in science. The interview progressed by asking children to express the extent of their agreement with 15 statements about science that had been printed on laminated card. The statements used during the card sorting activity were adapted from the comments made by children during the focus groups conducted in Phase 1 of the study. The statements spanned themes about science participation, the contexts of science learning, and who children are, who they are becoming, and who they hope to be in relation to science education. Children expressed their agreement, disagreement or uncertainty about each statement and provided their reasons. They also selected the two statements with which they most strongly agreed and two that represented their strongest disagreement. This latter selection allowed the children to confirm the key elements of their relationship with science. The statement sorting process is illustrated in Figures 3 and 4.

Figure 3. An illustration of the statement sorting exercise.

Figure 4. An illustration of a final set of sorted statements.

Children's focus groups

Of the 19 children remaining in the club at the end of the 2018/2019 academic year,[11] 7 provided parental consent to participate in focus group sessions to describe their experiences within the club. Two focus groups were conducted (one with 3 children, the other with 4) the week after the final club session in the usual club classroom; each group interview lasted approximately 45 minutes and was audio-recorded. The focus group questions explored how the children and other members of their community viewed their attendance at the STEM Club, factors motivating children's continued attendance at the club, what children learned at the club, and the children's recommendations for future science clubs.

STEM Club staffer interviews

Semi-structured interviews were conducted with 3 Visions of Science staffers at the end of the 2018/2019 academic year. Two of the staffers were leaders in the Prairie Lane club and one was the coordinator of the STEM Club program (in this report, we do not differentiate comments made by the staffers in order to support a degree of anonymity). During these interviews we explored experiences with the new club context, explored how the initial club objectives were addressed, and examined comparisons with other Community STEM Club settings. Interviews lasted between 30 and 70 minutes and were audio-recorded.

Focus group with school teachers

One audio-recorded focus group session was conducted with 2 teachers whose students had attended the Prairie Lane STEM Club. The interview took place once the club year had ended; it was audio-recoded and lasted approximately 60 minutes. The focus group questions explored the teachers' impressions of the STEM Club, looked at how the club had impacted the school community (including the children who attended the club), and asked teachers about the influence of the club on the classroom-based science education of children who attended the STEM Club. The interview also addressed impressions of the whole school showcase event and asked teachers for their suggestions regarding future iterations of a school-based STEM Club.

[11] One child enrolled at the start of the club year left the school before the end of the academic year; this was the only child to leave the club during the 2018/2019 academic year.

School principal's interview

Once the club had finished for the academic year, one audio-recorded interview was conducted with the school principal who had facilitated having the Prairie Lane STEM Club in the school. The interview was audio-recoded and lasted approximately 60 minutes. Similar to the interview with the teachers, the interview questions explored the principal's impressions of the STEM Club, and the influence of the club on the school community (including the children who attended the club). The interview also addressed impressions of the whole school showcase event and asked the principal for suggestions regarding future iterations of a school-based STEM Club.

Ongoing field notes

One member of the research team served as a volunteer in the Prairie Lane STEM Club alongside the Visions of Science staffers. This researcher supported club activities, as guided by the Visions of Science staffers, and recorded detailed field notes after each club session. Field notes focused on capturing events and activities of the club in a chronological order without any particular emphasis on interpretations or use of analytic frameworks.

Post-hoc field notes

Various views and perspectives of children and community members were captured by the Principal Investigator and another member of the research team through anecdotal field notes written after a range of club interactions, particularly focusing on the STEM Club showcase event at the end of the club's academic year.

Data analysis

Before exploring the club context, the children's introductory interviews were analyzed both quantitatively and qualitatively to summarize the children's background interest in science and investigate the factors influencing children's club attendance. Basic descriptive statistics (percentage responses) were conducted to identify patterns in the children's statement sorting responses. In addition, a thematic analysis of the various statement categories was also conducted to provide a contextual understanding of the ways in which the children sorted the statements. All of the focus group sessions, post-club interviews, and field notes were transcribed and analysis occurred with the support of NVivo qualitative data analysis software. Strategies for analysis of club data were based on the 7 objectives that emerged from Phase 1 of the study. In our analysis, we examined how the 7 objectives were represented, while allowing for new and relevant themes to emerge. A summary of the data sources and associated analysis is presented in Table 1.

Table 1. Data analysis summary

Method of data collection	Profile and number of participants	Analysis
Children's introductory statement sorting interviews: Individual statement sorting interviews with children at the beginning of the club year	14 children enrolled in the Prairie Lane STEM Club	Basic descriptive statistics of the statement sorting patterns and thematic analysis of commentary during the statement sorting decision-making process, based on the 7 objectives outlined in Phase 1 of the study
Children's focus groups: Focus group sessions with children after the last club session	7 children enrolled in the Prairie Lane STEM Club (2 focus groups of 3 and 4 children)	Thematic analysis based on the 7 objectives outlined in Phase 1 of the study
STEM Club staffer interviews: Individual interviews with Visions of Science STEM Club staffers after the last club session	3 Visions of Science staffers involved in the leadership and/or development of the Prairie Lane STEM Club	Thematic analysis based on the 7 objectives outlined in Phase 1 of the study
School Teachers' Focus group: Focus group interview with teachers in Prairie Lane Junior Public School after the club 'year' had ended	2 teachers whose students attended the Prairie Lane STEM Club	Thematic analysis based on the 7 objectives outlined in Phase 1 of the study
School principal's interview: Individual interview with the school principal after the club year had ended	The principal of the school hosting the Prairie Lane STEM Club	Thematic analysis based on the 7 objectives outlined in Phase 1 of the study
Ongoing field notes: Field notes based on each club session	The University of Toronto researcher serving as a Visions of Science volunteer making field notes after each club session	Thematic analysis based on the 7 objectives outlined in Phase 1 of the study
Post-hoc field notes: Field notes based on interactions with members of the school community (including parents) at various STEM club events and sessions	2 University of Toronto researchers making notes at various time-points throughout the academic year, including after the final showcase event	Thematic analysis based on the 7 objectives outlined in Phase 1 of the study

FINDINGS: CLUB CONTEXT

The subsections below are organized in general themes that provide an overview of: the club set-up; the relationships with science that children had before joining the club; and information about the club program.

Embracing the new club as an experiment

The new club set-up was not necessarily a comfortable shift for Visions of Science staffers; making so many changes at once was acknowledged as being a big challenge but one which they embraced as a great opportunity to experiment with the club format. As described by one of the STEM Club staffers, the new club seemed to break the rules of scientific experimentation and was far outside of the realm of comfort and normalcy for the STEM Club program:

> ***Coming from a science background and not having certain controls, and not changing certain variables, but kind of just saying: "You know what? We're just going to do something completely different, that isn't necessarily connected to what you guys do except for the curriculum, the training that the facilitators have gotten, and that's it!"***
>
> (STEM Club staffer, individual interview)

Nevertheless, plans were put in place and the club schedule was set. Visions of Science staff negotiated with the school principal to gain a permit for running the club in a dedicated classroom space at Prairie Lane Junior Public School. The club staffers identified the gift of having a space within the school that was not disturbed from week to week and that the club could claim as its own.

Children's enrollment in the Prairie Lane STEM Club

20 children attended the Prairie Lane STEM Club, based on return of parental permission forms distributed by the school principal (see Figure 5 for age/gender profiles of children enrolled in the club). Parents/guardians had been sent information about the new club by the principal via email and were advised to look out for forms being sent home with the children since spaces were limited. The children were notified about the club through their teachers and the principal and all forms went home on the same day. The first 20 children to return the forms were admitted into the club and a waitlist was generated for other children interested in attending the club. The club quota was filled on the first day of returning the permission forms. The words of the principal capture the excitement that was generated by the opportunity to have the club in that community:

> ***… before the forms went out, I had sent a [call, via email,] out to the parents, to let them know that this wonderful opportunity was coming, space is limited, and it's first come, first served. So, even before the forms went home that evening, because I'd hit the send button in the middle of the afternoon, I had parents on the doorstep, "I'd like a copy of that form" because they had read their emails, you know. So, it was so hard to, you know, have this waitlist, because parents were sending back the forms like, first thing the next morning. Kids were racing in before the bell rang with their form, you know.***
>
> (School principal, individual interview)

This extract illustrates the enthusiasm of children to attend the club that was borne out in the children's descriptions of enrolling in the club. As one child explained: ***"People say: 'I wish I was in it! It's not fair, you guys put your form in before the school even started!"'*** (Rose, Children's Focus Group 1). The principal went on to explain regret at having to turn children away from the club, despite their enthusiasm and the parents' desire

for their children to attend. This sentiment was echoed by other teachers in the school when discussing the 'selection process' for the club:

Teacher 1: ***Well, there's where a little bit of– I hesitate to say jealousy, but definitely some kids were disappointed that the numbers were limited and they didn't all make it in, because it was sort of first come, first served***

Teacher 2: ***Yes***

Teacher 1: ***It wasn't based on any kind of merit, it was simply first come, first served; you get your permission form in first and you are put in it, until we reached our max***

Teacher 2: ***And that was– I found problematic. You know, some kids just couldn't get here early enough. Where, you know, people were trying to sneak in through the building to give the form***

Teacher 1: ***Yes***

Teacher 2: ***And, just to make sure they would get it. And there were kids that I thought would have greatly benefit from it, and they just couldn't get in.***

(Teacher Focus Group)

In hindsight, it might have been better to give parents a bit more lead time so that concerns about meeting that deadline could be heard in advance of enrollment day and some kind of draw could have been carried out for all forms submitted on time. Nevertheless, the enthusiasm of teachers and the principal was conveyed to parents/guardians and children, and an excitement was generated around potential club attendance in the school community.

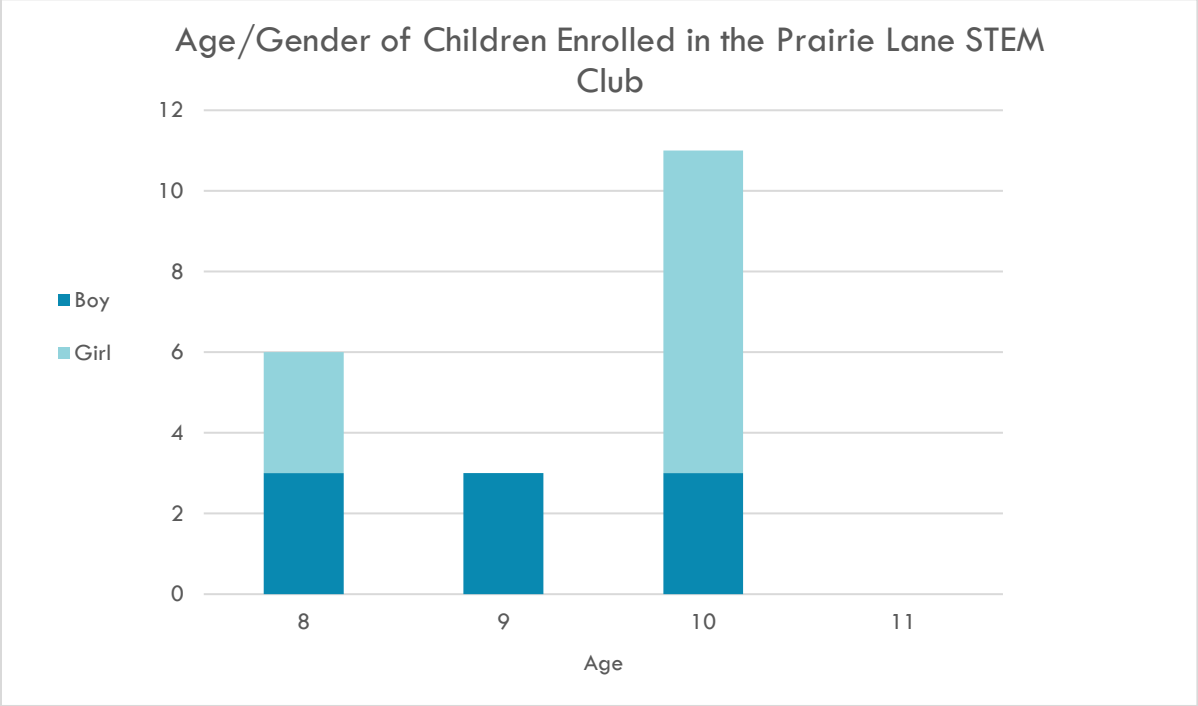

Figure 5. Age and gender profile of children enrolled in the club (ages in September 2018)

Science background of children prior to attending the club

During the first few weeks of the club, 14 children were interviewed to determine their background levels of interest in science education, how they had engaged with science prior to the STEM Club, and their hopes for the STEM Club activities. Key details of this information were fed back to Visions of Science as they planned for term 2 of the club's program. Figure 6 illustrates the age/gender profiles of club attendees participating in the introductory interviews and Figure 13 summarizes the children's responses to statements presented to them during the introductory interviews. Responses to statements are also presented thematically in Figures 7 to 12.

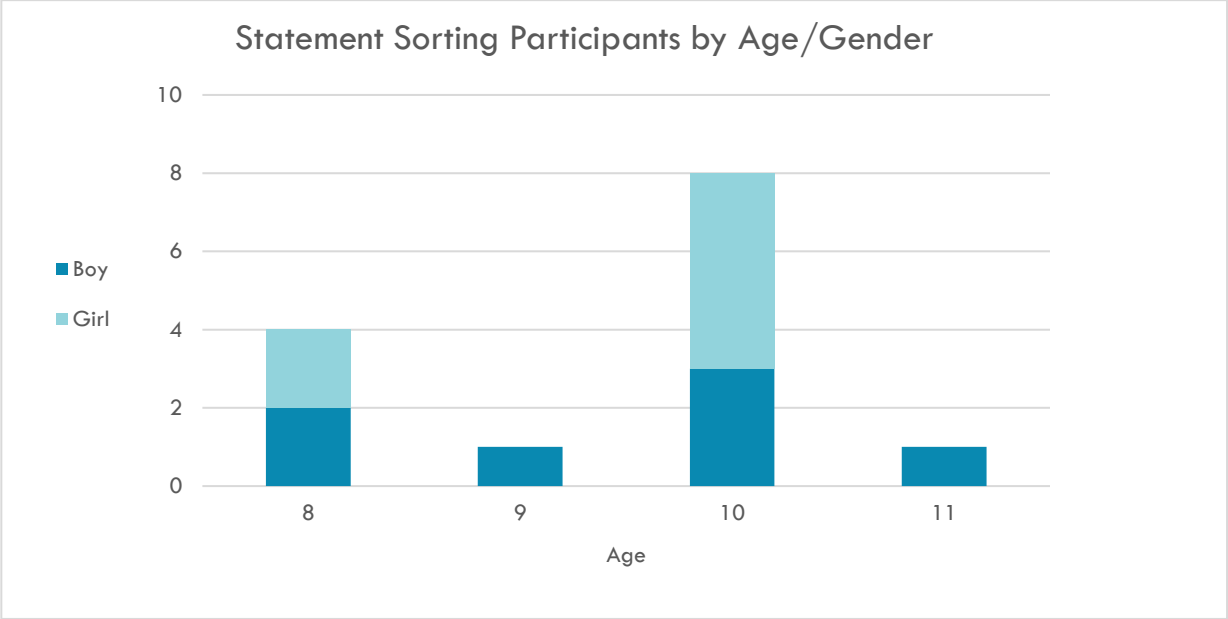

Figure 6. Self-identified age and gender profile of children participating in the introductory interviews (age at time of interview)

Who/what influenced the children to attend the club

Once the children were informed that attendance would be based on a first come, first served basis, they (and their parents/guardians) had to be very determined to ensure that the forms were returned to the school principal on time. Some children had conversations with their parents/guardians who advised them to make sure that they got the forms in on time, other children heard about the club when the forms were given out in class and hurried their parents/guardians to get the forms signed. One child described taking the form home and getting it signed right away by her mother, stating that ***"the very next day, before the bells ring, I rushed inside and gave it to the principal"*** (Ida, individual interview).[12] In most cases, this determination was fueled by the children's own interest in science but there were also one or two cases where the children were encouraged by enthusiastic friends/family to attend the club. One child described the need for an activity to do after school as they could not go home. Statements about being encouraged to attend the club by friends and/or family were often selected by children as their strongest points of disagreement (or agreement for a few). Many children

[12] To support anonymity, children's self-selected pseudonyms have been replaced with new pseudonyms, following the Atlantic tropical storm naming system, based on children's self-identified genders.

were very keen to assert that their own personal interest in science drove them to get the necessary support to sign up for the club. The fact that parents/guardians were so quick to provide written support for their children to attend the club indicated the impact of close community members on the children's participation in extra-curricular science education. Quantitative data is summarized in Figure 7.

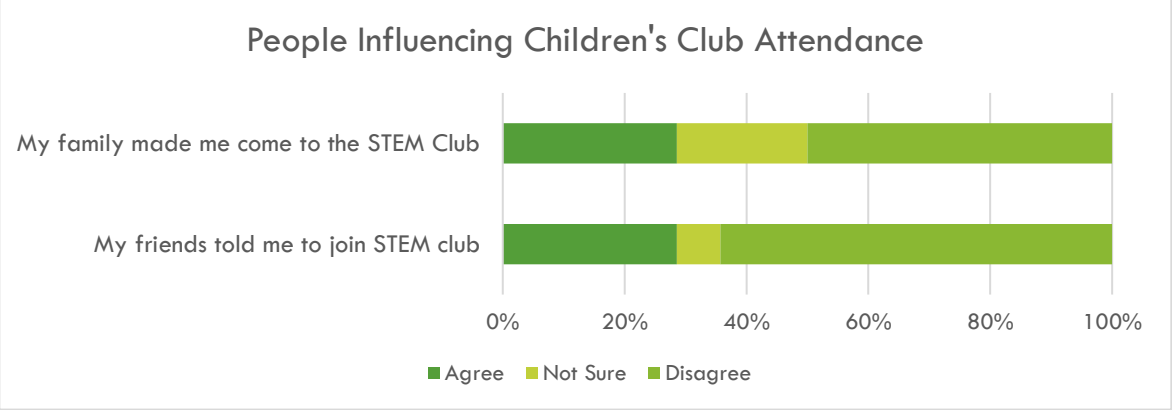

Figure 7. Responses to Statements 1 and 4.

General interest level in science

Although children were generally very enthusiastic about having a science club in their school, many children seemed unsure about whether their immediate community, particularly family members, knew about their interest in science. Only 3 of the 14 children interviewed were certain of their families knowing about their interest in science; these children explained that family members supported them in finding resources (including Internet materials) to assist them in pursuing their interest. For most of the children interviewed, having a science club at the school allowed them to stay in familiar surroundings (the school) while exploring a subject area that was already of interest to them. Children seemed pleased to have an activity to do after school that was not just focused on completing homework; nevertheless, as more than one child explained, there might have been some anticipation that homework support or supporting school work in some way would be a feature of the club: ***"if you have a science homework, or something, they could help you in, like, what if– they don't even know [that you have homework] and they just start talking about it and then you do your homework!"*** (Ida, individual interview).

Children described a range of topics within the field of science that seemed to interest them prior to joining the club and they were hoping to learn more about these areas. In illustration of the diversity of interest within the group of children interviewed, a list of some of the topics mentioned is provided below:

- Smoke bombs
- Rocks and minerals (mentioned by 3 children)
- Fossils
- Potions
- Robots
- Explosions
- Anything useful

It is interesting to note that a number of these topics overlapped with themes that are covered in the provincial curriculum for children of the age group of children attending the club. In addition, children mentioned the benefit of learning to do things that they could repeat at home. Quantitative data is summarized in Figure 8.

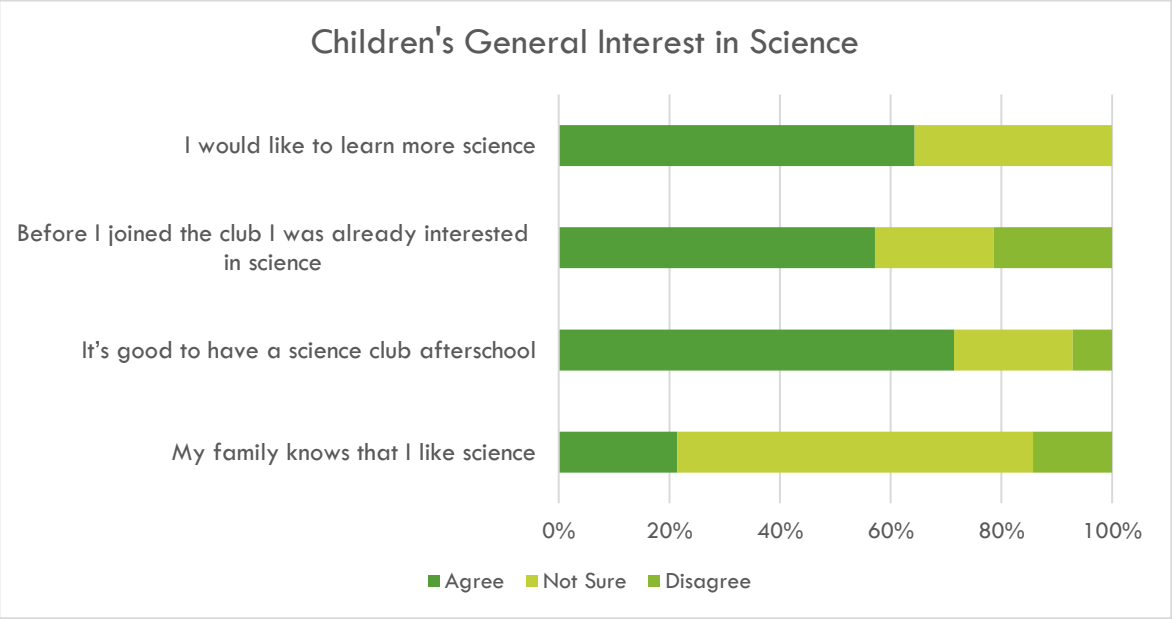

Figure 8. Responses to Statements 2, 3, 8 and 9.

Expectations about being good at science

Most of the children interviewed described their comfort with the idea of not necessarily being good at science. In explanation, children presented reasons that aligned with the growth mindset model that is commonly promoted within the provincial school system. This was illustrated well by one of the children who explained:

> ***It's okay if I'm bad at science because I can just learn more and I can, if I get a science test, I can do better than I did last time, 'cause last time I got a B minus or, no, wait, I got, in Grade 3 I got a B minus and in Grade- last year the test was really hard so I got a C plus.***
>
> (Claudette, individual interview)

This idea of being able to make improvement, even if you start out at a position of not knowing anything, was repeated by a number of children in comments such as ***"you could learn more"*** (Larry, individual interview), ***"if you are bad then you can learn more"*** (Bill, individual interview), and ***"you don't have to be good but you can always try"*** (Kate, individual interview).

Even though children were positive about their potential to be good at science, they expressed a lot of uncertainty with regard to others' expectations and assessments of the children's abilities. When positive expectations were expressed, children described these as coming from their family members or their teacher. In one case, the encouragement came from a friend who was good at science and wanted the child to be good at science with them. Quantitative data is summarized in Figure 9.

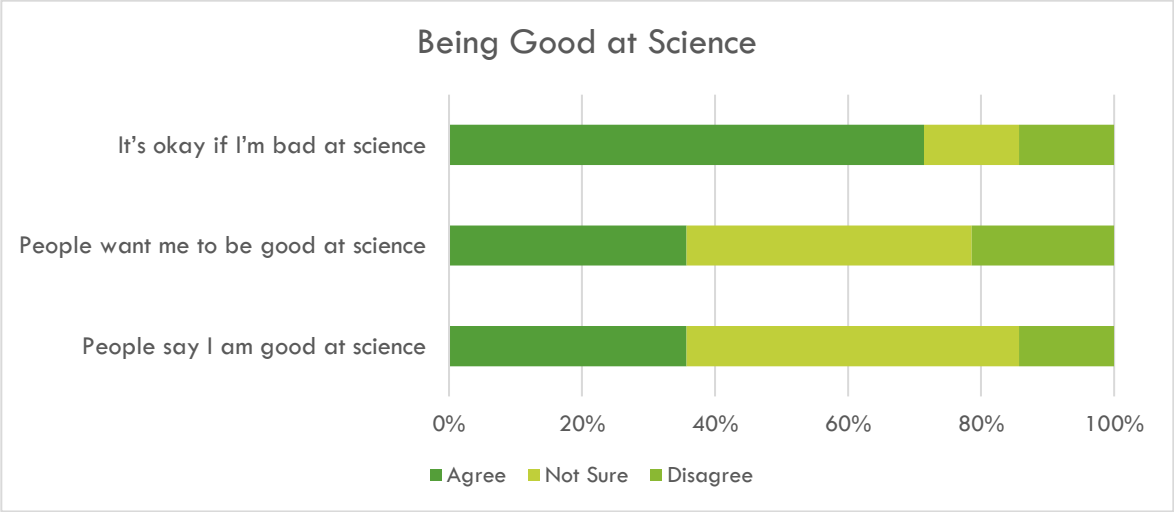

Figure 9. Responses to Statements 11, 12 and 15.

The everyday value of science

Most children interviewed agreed that science is useful in everyday life but they had difficulty articulating any ways in which they experienced the value of science in their own lives. Children gave specific examples of learning about ideas such as gravity or the use of pulleys in self-closing doors, or just asserted a belief that science was generally useful in a nebulous kind of way; as described by one child: ***"You can make stuff that can help you with your living, like, stuff that can actually change your life. Like, scientists make stuff, invent stuff that change people's life."*** (Odette, individual interview). It was interesting to contrast the certainty with which children asserted the usefulness of science (a number of children stating that they had very strong agreement with this idea) with the children's difficulty in articulating, with any specificity, how science is useful. Quantitative data is summarized in Figure 10.

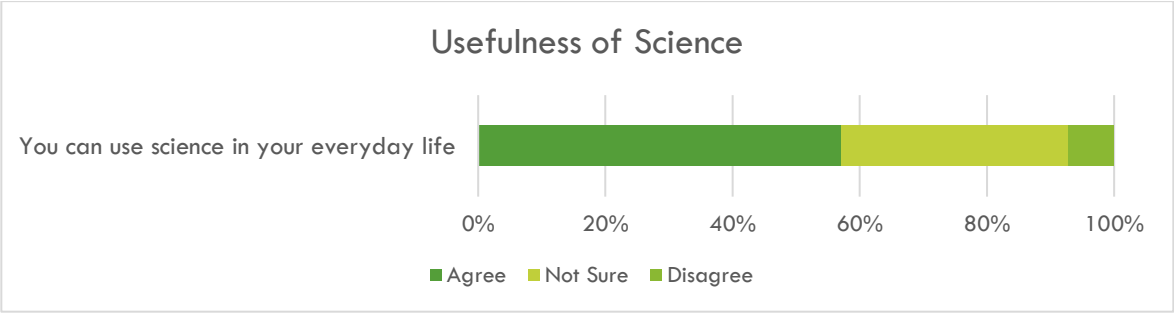

Figure 10. Responses to Statement 14.

Links between school science and out-of-school science

The majority of children interviewed reported conducting science-related activities outside of school. Half of the children stated that they strongly disagreed with the statement that they only did science at school. A number

of the children described conducting research via the Internet or completing homework (sometimes both). For a couple of children, parents helped them to plan extra-curricular science activities by purchasing resources or taking them to clubs or the local science centre. Children described their hopes that the STEM Club would do more than the science education they were receiving at school in terms of being more interesting and learning new things or going into more depth with regard to topics they had already met. One child explained how his STEM Club activities were already influencing what he was doing in class:

> ***My teacher actually said that once we finish the, like you know, social studies, math, for example we are about to be finished math, instead of doing like just playing games, he is going to do some STEM stuff. But he has some other things like lava lamps, or maybe some glow-in-the-dark fireworks.***
>
> (Henri, individual interview)

In this situation we saw that, even early on in the club's experience with the school, teachers were being inspired and influenced to connect what they did in class with the kinds of experiences that children were having at the club. Quantitative data is summarized in Figure 11.

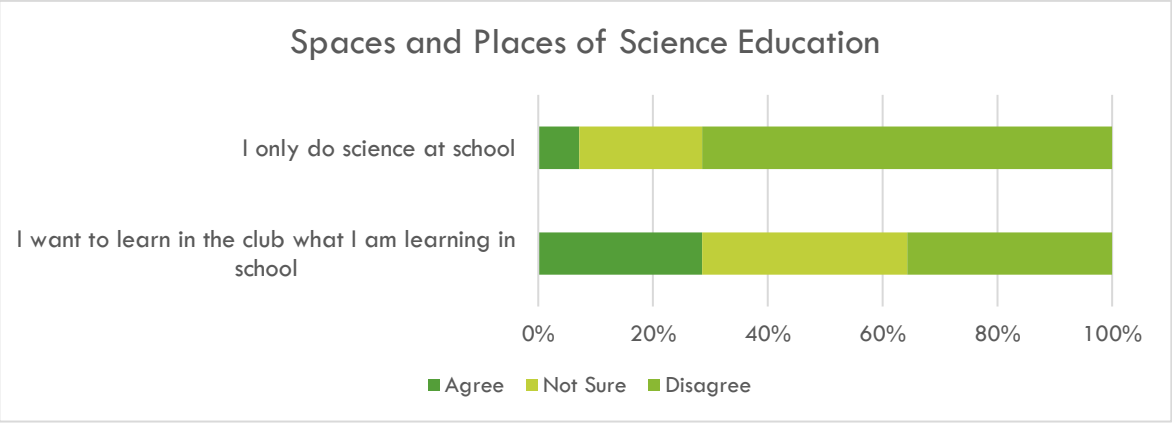

Figure 11. Responses to Statements 6 and 10.

Science career aspirations

It was clear that, although most of the children interviewed expressed some interest in pursuing science-related careers, they wanted to know more about the nature of those jobs and had very little familiarity with people who worked in the science field. Even children who were quite decisive about their interest in doing a science-related job were often uncertain about what that job might entail. Children had an interest in asking scientists about their backgrounds, how they got into their careers, and about the most exciting experiments they performed. As one child explained, she would want to ask: ***'"how did you get inspired to do science?' and like 'what do you like about science?' to see if we like the same things"*** (Elsa, individual interview). Children were curious to know more about the everyday lives and activities of scientists with nearly half of the children stating that they agreed very strongly that they wanted to meet a scientist. The people children identified as scientists were public figures (like Bill Nye), people they learned about in school (like Isaac Newton or Neil deGrasse Tyson), or teachers. Two of the children stated that they had family members who have science-related jobs. Quantitative data is summarized in Figure 12.

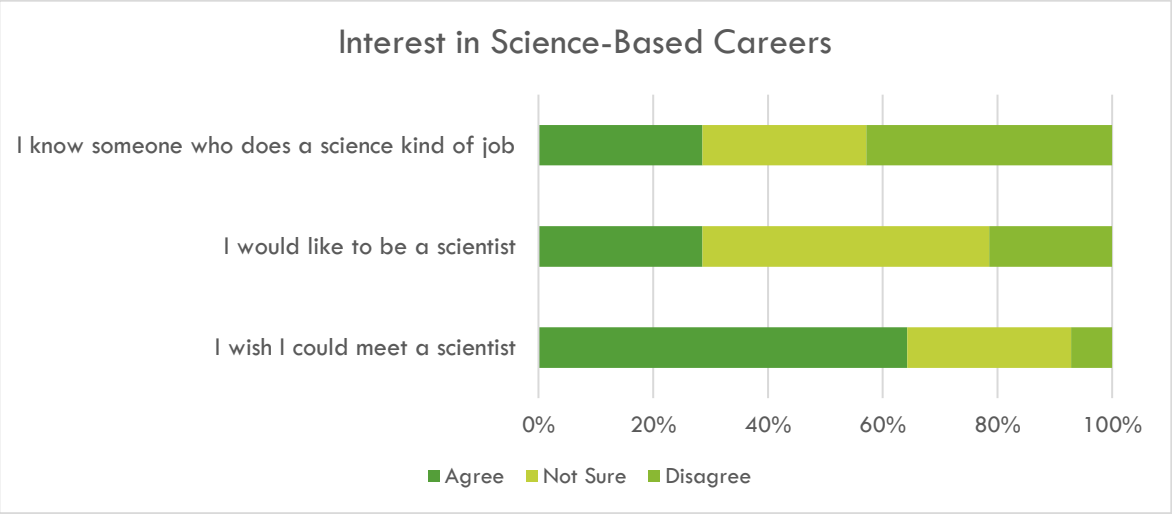

Figure 12. Responses to Statements 5, 7 and 13.

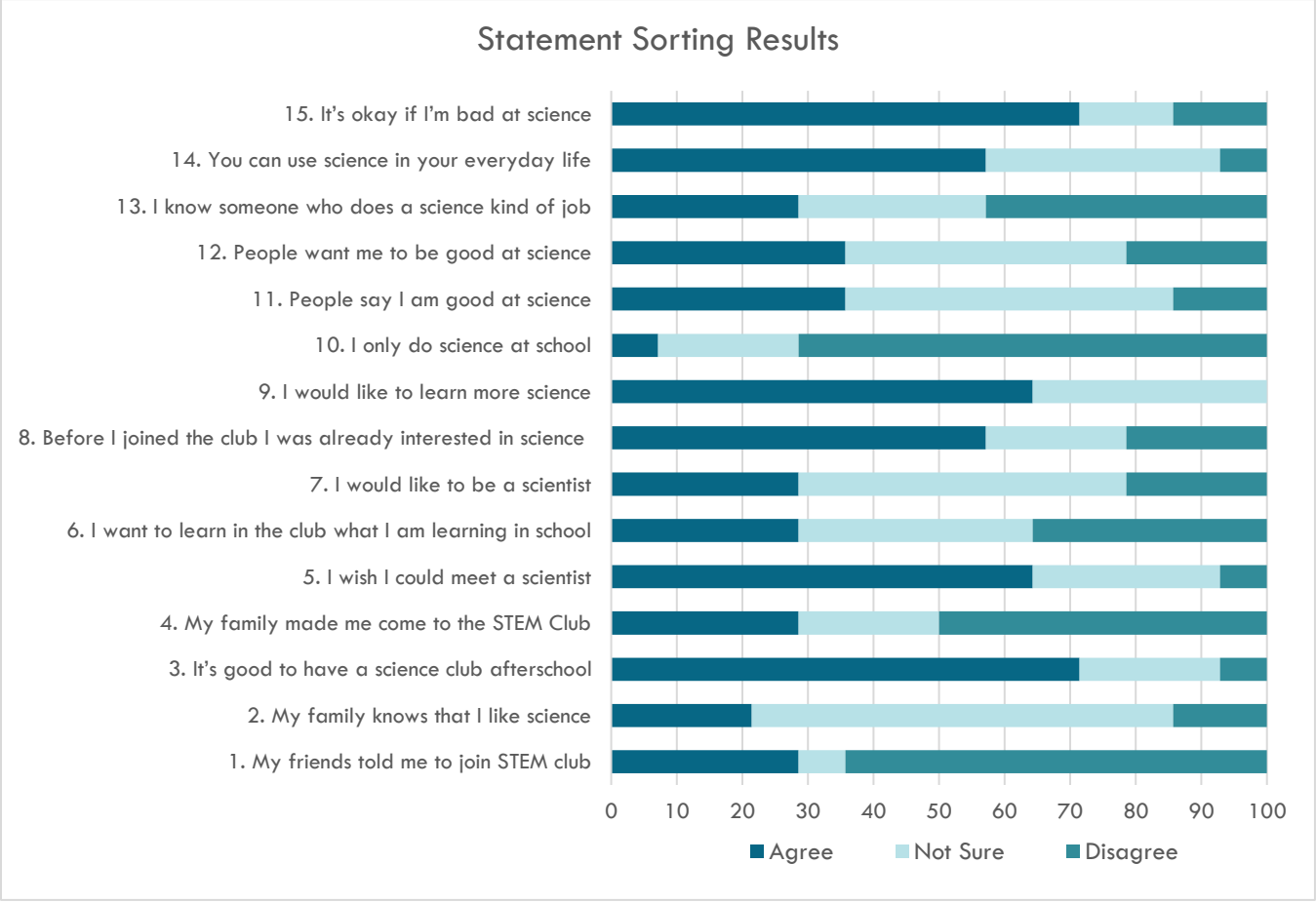

Figure 13. Item-by-item responses to the statement sorting activity conducted by the children.

The club program

It was proposed that each club session would consist of a mixture of team-building activities, group-based STEM tasks and activities, and a debriefing/feedback session. Before children arrived in the classroom, the room was set up and the session activities were written on the chalkboard along with guiding questions for the main activity.

Very quickly, the STEM Club leaders appreciated the priority of providing the children with a snack soon after arriving at the club. Given that a number of the science challenges involved working with food items, it was important to focus on making sure that children were not hungry after completing a full school day otherwise the children would snack on the experimental resources. In other after-school club programs, the hunger issue has been addressed by providing inexpensive, high-carb snacks (like family packs of pretzels or crackers) that are always available to children; if they ask for those snacks, at any time, the answer is always yes. This arrangement can avoid the idea that food is something to be rationed.

One other addition that occurred within the first few weeks was the inclusion of outdoor activity time to mark a distinction between school and club time. Most of the outdoor time involved free play but there were occasions where team-building games were organized.

One activity that was modified/removed was the Plicker feedback session;[13] there were numerous challenges with the use of this technology at the end of each session, when children were lacking in focus. After the winter break, the Plicker feedback was removed from the schedule, and children were asked to indicate their engagement with the week's activities by marking their responses to questions written on the board. It is unclear how this feedback was used but providing some form of summary to the children at the start of each subsequent session may be a means of responding to feedback and supporting continuity. As a final form of feedback before leaving the club, each child used an 'emotion chart' to select an emoticon that summarized their feelings about the session. As a research team, we saw ways in which a summary of information could be shared with the children. If the Plicker technology is useful (due to the instant graphical feedback generated) it might be valuable to conduct the review activity at the start of a subsequent session as a reflection on the previous week; this might also allow for a more considered reflection on the educational experience by the children.

Most of the science-related group activities were based on challenges or tasks that contained a puzzle element. Outside of the showcase projects, very few activities (indeed, only the Holiday Lights activity) spanned more than one week and, in subsequent weeks, there was little reference to activities of previous weeks. Over time there was a distinct decrease in the amount of time spent preparing the whole group for activities; instead, more time was focused on the children engaging with the task for the week and whole group time was spent on team-building activities. One STEM Club staffer explained that this truncation of lead-in time and reflection time was due to the sessions being 15 minutes shorter than the 2 hours for which the modules had been designed:

> ***In this space within the school it was right after school … They finish up, they come to us. A little bit less time, I think it was an hour and 45 minutes, which 15 minutes can be a lot for certain days, considering the prep for the day that goes on or even the session. A lot of times you kind of just go with their interest and if***

[13] Plicker resources available from https://get.plickers.com/

> ***they're very interested in the session, like maybe if there's other things that are a part of it. We just don't even do it, because you know this is what's capturing their interest in the moment.***
>
> (STEM Club staffer, individual interview)

At the end of each session, the STEM Club staffers completed a skills chart, awarding stickers to children for leadership, resilience, and teamwork. Children and parents were thrilled to have this skill development recognized in such a personalized way in the awards ceremony at the end of the showcase event. To complement these more generic club skills, it is possible that clubs might have a skills chart focused specifically on science skills such as: researching to find out something new (research); testing and retesting for improvement (tenacity); being inventive or using ingenuity (creativity). The choice of skills selected could help to define what aspects of science learning are valued in the STEM Club setting.

FINDINGS: COMMENTS ON THE CLUB EXPERIENCE

The following subsections provide insights into recurring themes about the club experience that emerged within the participants' commentary. They particularly emphasize the highs and lows of experiences within the club from the perspectives of children and STEM Club staffers. Additional comments specifically related to the impact of the club on the children and the school community are provided in the Appendix.

General comments

Children attending the club were aware of their good fortune with regard to attending the club. As described by two of the children: ***"Sometimes people say it is not fair that you guys get to go and we don't"*** (Teresa, Children's Focus Group 1) and ***"My family and my teachers were like, you are lucky to be in this club because it's a life-time opportunity and all of that blah, blah, blah"*** (Danny, Children's Focus Group 2). There was a general sense of achievement at even being included in the club number, so much so that children did not need to be coerced into going to the club each week. As their teachers explained:

> ***Teacher 2:*** ***Yeah. The kids that went I know that they were committed to the program, so there wasn't ever a time when I heard, like, you know, 'I don't feel like going today, so I'm not going'***
>
> ***Teacher 1:*** ***No, it never happened***
>
> ***Teacher 2:*** ***It never happened. And then, when it came Monday afternoon, they knew exactly where they needed to go, and they went. You know, it was just really nice to see.***
>
> (Teacher Focus Group)

The children could hardly contain their excitement when describing how much they enjoyed being part of the club. Key elements for the children were the fun and the food, repeatedly mentioned together. As described above, club staffers appreciated, very early on, that it does not pay to have the children waiting for their snacks at the end of a long school day. The children often arrived very hungry, even bringing their own snacks to the club. At times children were disappointed that they were expected to wait for the snacks or that their specific dietary requirements had not been accommodated. As with any relationship-building experience, over time the club staffers got to know the children's dietary needs and preferences without referring to their records.

Ultimately, the children were very upset that the club finished early in the academic year. Older children were also disappointed that they would not have the opportunity to attend the club when they moved to the local middle school. We note that one child emphasized just how close the new school would be to the current club location and we saw a potential opportunity in this observation. For school-based clubs, there may be scope to get those who may be moving on to a middle school in the area to come back to the club after school as helpers; this may maintain the community connection and spread the influence of the club into the middle school context. It would also help to develop the leadership skills of the older children.

The activities

Children seemed to enjoy the vast majority of the activities carried out in the club. Repeated mention was made of slime-making and any activity involving food. Indeed, after the slime session, members of the research team were told by children and teachers about slime-making happening in multiple classrooms across the school.

For the children, the least enjoyable activity seemed to be one of the presentations made by a visiting scientist. In their introductory interviews, many children had described wanting to meet a scientist but the children were

not asked what type of scientist they would be interested in meeting (although it is unclear if they would have been able to articulate this with any specificity) or what they would like to know from the scientist. Children had not prepared questions or provided any input as to what they would like the scientist to share with them so it was difficult for them to make the most of the experience. Never knowing what to expect from week-to-week seemed to be a feature of the program, and certainly raised anticipation levels for this group of children but, on this occasion, it seems as if children lost out on a potentially rich and engaging experience because they were unprepared and found it difficult to fully engage.

The showcase event represented a highlight and culmination of the club program. Children identified certain organizational issues that resulted in them being unable to fully demonstrate their project in its best light. As explained by members of children's focus group 1:

Interviewer: ***And what did you like and dislike about the showcase, remember? The final day, the project?***
Teresa: ***Yeah. That was kind of the last thing?***
Interviewer: ***Yeah***
Teresa: ***At the end, when the parents were coming, a lot of people weren't really coming to our centre, mostly.***
Interviewer: ***What was your science theme?***
Teresa: ***Slime. Because, the other groups kept on– so, if people were at our station the other groups would go to our station and tell them that they are starting the presentation, when they're really not, so that the parents could stay at their place. Then every time the parents came back, they would do it over and over***
Nicholas: ***We didn't do it …***
Rose: ***Not your group, wait, was your group the volcanos?***
Teresa: ***Yeah, your group, part of …***
Nicholas: ***Well, I didn't do it.***
Interviewer: ***What was your science theme? The slime as well?***
Teresa: ***Same thing***
Interviewer: ***Oh***
Nicholas: ***Mine was volcanos***

(Children's Focus Group 1)

Despite these hiccups, children took pride in describing how the showcase illustrated their abilities to talk to people and demonstrate what they had learned. The children were taken seriously at the showcase and many of them rose to the occasion, preparing scripts and interacting with their audience. As one child explained ***"I really had fun showing our parents how smart we are, 'cause I think we are underrated, we are the underdog kids, you know what I mean?"*** (Henri, Children's Focus Group 2). Henri seemed to have an awareness of the challenges that face children in low-income communities. It would have been nice for children to have had opportunities within the club to discuss how living and being educated in a low-income community impacts them and can lead to social challenges to their science education.

Relationships with peers and staffers

The STEM Club staffers faced many challenges with children who brought to the club setting the spats they were having with classmates during the day. This challenging context helped children to learn how to resolve

differences in the absence of an authoritative teacher or parent. This resulted in the staffers being seen as helpful and protective friends who worked through issues with the children and helped them in their growth as members of a sub-group of their local community. Members of children's focus group 1 described how remaining at the end of a school day and completing fun activities was also an opportunity for relationship-building:

Teresa: ***And we get to chat with our friends, more than usual***
Rose: ***We got to see [STEM Club staffers]***
Nicholas: ***We get to do all the activities***
Rose: ***Yes, we don't go straight home***

(Children's Focus Group 1)

Children were very excited about staying in a different area of school at the end of the school day and there were numerous instances of children going off and 'exploring' the building. This was initially challenging to the STEM Club staffers but they eventually managed to establish certain expectations that helped the children to self-regulate for the sake of the whole group. These initial challenges were described by one of the club staffers:

Staffer: ***Yeah, so, [laughs] the biggest challenges were, like, some of the children, like, I guess they got easily distracted. And so, they would be like, doing things like, running around the room, throwing chairs around, just like, running outside, like, going to the washroom for so long, and so, that was, like, the biggest challenge for me. Like, you know, having that open space, but then also, being like, "But hey, like, we're over here!" So, that was, like, the biggest challenge for me.***
Interviewer: ***And how does that normally play out in the other club spaces? So, are they a little more contained?***
Staffer: ***Yeah, because, we don't necessarily have, like, a big school to run around in.***

(STEM Club staffer, individual interview)

Staffers persevered in building relationships with the children and over time understood a little more about the school context and the challenges that children experienced; this helped the staffers to look beyond the behavior and see opportunities to support the children in ways that were readily identified by teachers in the school who referred to the staffers as both counsellors and scientists:

I could see that they connected with them and they were very relatable and they understood, you know, that some of them may have had issues or bad behavior or whatever, but they, you know, but the counsellors that worked with them, or the scientists that worked with them were very cognizant of that and, you know, I don't know, they got along really well with them.

(Teacher 2, Teacher Focus Group)

The same teacher added:

I really, really appreciated the fact that people that were working with [the children] represented their community because, particularly, the representation matters. So, to see a young black woman, being a scientist, or a young black man, being a scientist, I think that was so super-important for [the children] to see that and to see them being in that role, and to see just how much science should be appreciative and accessible for everyone. So, that was a huge thing that I saw, and the kids were really connected with them.

(Teacher 2, Teacher Focus Group)

This connection with the staffers was described by many of the children who were so happy to spend time with relatable adults who cared about and cared for them in an informal setting. Indeed, after explaining how great relationships were with the staffers, one child went on to explain that the potential for good relationships seemed to be true for all Visions of Science STEM Club workers, stating: ***"The most part that I had fun was that, that the person that kind of owns the thing, the STEM Club, most he likes basketball, and we were talking most of the time, we had pizza– we had cupcakes–"*** (Henri, Children's Focus Group 2). Even this brief encounter with one of the STEM Club leaders suggested to the child that all club administrators were likely to be fun.

IMPLICATIONS: ADDRESSING OBJECTIVES FROM PHASE 1 OF THE STUDY

The following subsections examine a thematic analysis of the Prairie Lane STEM Club activities, based on the objectives outlined in Phase 1 of this research study. Understandably, there were different priorities placed on the various objectives so some may have been more significant, or have been more readily feasible, than others when exploring a new club model. Below, approaches taken during year 1 of club implementation are examined and possible lines of inquiry for future iterations of the club are suggested.

Exploring partnerships with community organizations

Given that the club was located within a school, many intentional and coincidental interactions with the formal educational setting were inevitable. When describing these interactions, teachers and staffers were very positive about how productive those encounters had been. There appeared to be a seamless fit, where the STEM Club staffers were distinct from the school community but in some very tangible ways integrated with it. We saw a lot of potential for these links to be enhanced without compromising or over-stepping the bounds of formal and informal educational objectives and expertise.

The fact that the only selection criterion for attending the club was having the parental permission form signed and returned before enrollment was full meant that the club contained a cross-section of children in the 8 to 11 age range. The STEM Club staffers had no idea who they were expecting to attend on the first day of the club since recruitment was largely conducted by the principal and other teachers. So, the club members represented a true cross-section of the school's community. Indeed, as one parent explained to a member of the research team, her child had special needs and, for that child, it was good that there was no specific selection process as the club represented the highlight of her child's week. The principal explained they did not use behavior, academic performance, or any other criteria beyond returning the form, to select children for the club so there was a real mixture of children attending, and all seemed to really enjoy the experience: ***"I mean, we have one student who was quite challenging, but that program he's hooked. He is so hooked!"*** (School principal, individual interview). The principal then went on to explain how that same child had forgotten his "special t-shirt" so was very distraught and rude to the teachers on the day of the showcase but, eventually, he was taken home and picked up the shirt. He returned to apologize to the teachers the following day, stating how much he had enjoyed that final event and how he realized that he could have really missed out on something if he wasn't able to participate. The principal summed up the incident by explaining how much the club meant to the parent and the child, recounting the words of the parent in a phone conversation:

> ***She [the parent] says, "I know how much he enjoyed the program, and how much it supported him, his social and emotional well-being at the end of the day, that to not have him participate in this culminating task would've been a problem."***
>
> (School principal, individual interview)

The enthusiastic and intermediary role of the principal and teachers was so fundamental to the efficacy of the program. So many times, we saw how teachers would contribute informal comments to staffers about a child who was 'having a bad day' or who was facing a particular challenge that week. These informal interactions marked the time of changeover from school to club setting but helped to bridge the transition for the child. These periods of overlap also allowed teachers to get exposure to the club, seeing their students in a different setting. This was somewhat unusual for STEM Club staffers, one describing how the usual club context is:

> ***… a bit more private in the sense that there aren't people that are kind of strolling in or– Even if it's a– like, typically we do it in like a recreational room within one of the buildings or something like that. Occasionally in a community centre, but even in those cases, like, it hasn't necessarily been like people kind of strolling in and they're looking and they're, like, what is this? There are people that do come, but they more come with a purpose, like picking up—***
>
> (STEM Club staffer, individual interview)

Similar overlap was seen with parents at the end of each session and allowed club staffers to gain insights into the enthusiasm and expertise of parents (some of whom had STEM backgrounds). It is possible to imagine that in future iterations of the club there may be opportunities for parents to collaborate with STEM Club staffers in some of the club sessions (this is discussed further below).

Teachers identified other community spaces and places that may have meaning for the children where they had heard that one-off science events are occurring and there may be potential for STEM Club collaborations. These included cultural centres and places of worship (mentioned by one or two of the children during interviews). It was also suggested that city Parks and Recreation organizations may be particularly supportive in planning outdoor science activities for the children such as indoor-outdoor gardening programs, reliant on scientific strategies and controls.

Recognizing community funds of knowledge

It was a challenge for the STEM Club staffers to navigate the unfamiliar context of the new club setting while finding ways to honor and value knowledge and expertise of local community members. Indeed, this can only be done when there is enough knowledge of and sharing with other members of the community. For example, when there are apprehensions associated with the perceived mismatch of having an informal science club situated within an institution of formal learning, trying to establish the club as a legitimate participant in a community space can often be given higher priority than learning from community members:

> ***Yeah, it was just like, maybe they didn't really understand, like, how we function. Like, and like, how we like to teach and how we like to let children explore certain things. And when teachers are in our space, it kind of changes the way we do things. And so, I was definitely worried about that, but we didn't have that problem, luckily. So, it went really well. It ended up going well.***
>
> (STEM Club staffer, individual interview)

Some of the anticipated issues had been mitigated by the fact that the Prairie Lane school community (staff, children, parents/guardians, and others community workers) were so welcoming of the club and had provided input during Phase 1 of the research, prior to the club being placed in the school. Under these circumstances, it was not difficult for community members to see the club as 'theirs', supporting and defending the club activities and space. In future iterations of the club, in other school locations, it could be envisaged that interested community participants could be invited to share their concerns, interests, insights, and expertise with Visions of Science staff at a meeting prior to the launch of the club. Such meetings could become annual opportunities for Visions of Science to gain feedback and knowledge insights from community members who know the children best.

An interesting spin-off from the club being situated in the school was the acquisition of knowledge by the community, mediated by the children who attended the club. Children were so keen to share their knowledge

with family, friends, and teachers that STEM Club activities were making their way into the broader community space. One example was shared within the teachers' focus group:

Teacher 2: ***And some of them– I even know that two students took something that they learned from STEM and they made me a little Christmas card***
Interviewer: ***Oh, how cute***
Teacher 1: ***Yeah, I've got the Christmas card too.***
Teacher 2: ***It was really nice***
Teacher 1: ***Yeah, they wanted to give me that LED light Christmas card, they just thought that was so marvelous.***
Teacher 2: ***Yes, "how did you guys do this?", so they were telling me and explaining it to me and so–***
(Teacher Focus Group)

Teachers spoke of the pride they had in seeing their students as knowledge bearers. This also rang true for the showcase event where children presented themselves as knowledgeable 'science people', keen to share what they had learned. The teachers suggested how this sharing of knowledge could be expanded and went on to propose a model where the STEM Club and the school system would have very complementary roles in the education of the child. Teachers proposed that, provided that the club covered at least one or two activities that overlapped with topics that the children were covering that year in school, STEM Club children could support classroom activities by demonstrating their knowledge to their class and leading out during the practical activity. This would give children an opportunity to become classroom experts, building their personal confidence as learners and encouraging them to conduct additional research and seek feedback from their home community context as they prepared to take a platform in their classroom setting.

Teachers also proposed that STEM Club children could serve as 'science ambassadors' in the school, making presentations to various school groups. Indeed, this idea had already been presented to the children by a teacher who was not involved in the research study. As described by one of the children during the focus group discussions:

Rose: ***Oh, there was this one teacher, you know, when we were presenting? Her class didn't come … and she asked, I think it was me and [another child], when we went to put the attendance, and she asked if we could present to her sometime***
Interviewer: ***Oh, something about …***
Rose: ***She said she'll buy the materials. I told her we were doing science, she said she'll buy the materials***
Nicholas: ***Who?***
Rose: ***[Teacher name], and she said she is going to buy the materials and we are going to show her, her class, how to make it***
Interviewer: ***So, what have you chose for that?***
Teresa: ***Slime, because we really like playing with slime but that day we made it.***
(Children's Focus Group 1)

The teachers went on to explore ideas such as STEM Club staffers circulating between classes, accompanied by 'science ambassadors' to share science club activities with students who are unable to participate in the club.

This would strengthen the relationship between the STEM Club staffers and the school community. One of the teachers described this as an alternative to the early years of the 'Scientists in School' model.[14]

As an alternative to the showcase format, one teacher outlined a way that the different inquiry groups could be set up in different classrooms around the school during that designated showcase time:

> ***Teacher 2:*** ***'Cause, I really do like the idea. One of things that I found difficult with the showcase, even though it was great, was that, because it was in the gym, it was really, really hard to hear***
> ***Interviewer:*** ***Yeah, and some of them were shy***
> ***Teacher 2:*** ***And they were shy and then they were like: This is what you do, this is what you do– But they were trying to explain what was happening but no-one could hear them***
> ***Interviewer:*** ***Yeah***
> ***Teacher 2:*** ***And I thought like– Oh, it would have been more– I wish that– the classes–***
> ***Interviewer:*** ***They were circulating in the classes rather than the classes come to them***
> ***Teacher 2:*** ***Yes, in the classes– If was set up in a classroom, and then the school would have been going into different classrooms.***
>
> (Teacher 2, Teacher Focus Group)

Other ways of recognizing and valuing community knowledge could be to identify parents/guardians who might have expertise in science-related fields and invite them in to support activities during select club sessions. These 'guest expert days' would allow parents/guardians to work alongside the children rather than just lecture them, circulating, mingling, and supporting as children complete activities. Similarly, a Q & A panel session might be planned with people who do interesting science things in the community; each person could provide an interactive demonstration of something they would do in their everyday work life.

Exploring contemporary approaches to science education

The Visions of Science STEM Clubs maintain a central focus on inquiry-based learning with an emphasis, for the new STEM Club, on children's self-directed inquiry; this is discussed further in a later section of this report. Other research-based approaches that support the development of children's engagement with science (identified in the study's interim report), such as place-based strategies that work to develop science literacy, scientific citizenship, and/or science for action, were not really evidenced in the Prairie Lane club. The researchers did not gain any evidence to suggest that activities had been tailored to the local context in any particular way. Children were encouraged to go outside at the start of sessions but these opportunities were largely focused on breaking up the day for the children (who had just come from a challenging day at school) and marked a transition from school time to club time. Given that the children were often caught trying to explore the corridors of the 'after hours' school, it might have been fun to have the children conducting activities that investigated the school as an institutional space that runs on scientific principles. Activities such as conducting an energy audit around the school or engaging in a science learning trail in the green space around the school can help to promote a sense of place and belonging for the children. Encouraging the children to see how science can be used to create and maintain their immediate school environment can also help them to have a greater sense of connection with the community space on which the school is situated.

[14] The origins and ethos of the Scientists in School model, developed by the Canadian Federation of University Women, is described on the organization's website: https://www.scientistsinschool.ca/about/history/

Generating connections with the school space can lead to action for and with the school community. As described by one child in focus group 1, the children are used to thinking about how their learning can be used to impact others:

> ***Teresa:*** ***I would think, going on trips, oh ...***
> ***Interviewer:*** ***Trips where?***
> ***Teresa:*** ***I don't know, like zoos and stuff, going visiting people, raising money for stuff***
>
> (Children's Focus Group 1)

Children in focus group 2 also had a protracted conversation about their dream club being a place where they see science in everyday trips, such as when they visit the community pool and think about water pressure and the various things that need to be tested to maintain the facility. Again, finding local sites of scientific activity for the children to engage with can help the children to see themselves as participants in a community where science is important.

Exposure to primary research in science education

There was no evidence that primary research literature associated with valuing community funds of knowledge or exploring community-based and community-responsive education was shared directly with STEM Club staffers but we saw evidence of these literatures (introduced in the study's interim report) influencing activity planning in the Prairie Lane STEM Club. The researcher assigned to the club was usually only consulted for her teaching, rather than research, expertise; so, an opportunity to see her as a research resource may have been missed here. Since each club context is unique, how this literature is used (and useful) is likely to be different from one club to the next. One approach to engaging with this literature could be for a designated researcher to circulate articles (or article summaries) for club staffers to read then hold regular (say, bi-monthly) themed meetings with club staffers to explore and discuss the relevance of the article to their given club context, in a book club fashion. It is always so important for these community-based ventures to stay at the leading edge of research and developments in children's community-based programming (as has been endeavored through this research study).

Supporting the diversity of children's interests

We found the introductory statement sorting exercise really useful for gauging children's interests in science and the topics that were engaging them at that time. The research team did not bring these topics to Visions of Science since the plan for term 2 had already been set but it is not surprising that many of the topics that interested the children overlapped with school curriculum topics and it would be interesting to find ways to build on some of these areas of interest to augment the children's school science experience. When making suggestions for any new club that is based on the same community-responsive principles, one of the STEM Club staffers identified this approach of seeking children's input as well-suited to the way in which the club had developed over the year:

> ***So, I would like to speak to the kids prior to starting the club, and have them talk about, like, what things they're interested in before we start. You know, it was like, it was nice to, like, we did do that, like, before the second term, and that's when we brought in everything they liked, but it would've been nice to just start that way.***
>
> (STEM Club staffer, individual interview)

Staffers also suggested that the narrower age range (Grades 3 to 5) of the children might have made it easier than usual to gauge interests because children in the same age category in the same community tend to have similar background experiences. This does raise the possibility that if school-based clubs are heavily over-subscribed, younger and older categories (e.g., Grades 3 to 5 and Grades 6 to 8) of club might be run in the same school with activities that are focused on age-appropriate interests to support children's engagement, particularly for junior middle schools.

A key component explored in the Prairie Lane STEM Club was supporting children as they pursue areas of personal and collective scientific interest. The opportunity for small-group extended inquiry was made clear in the run-up to the showcase activity and children seemed to really enjoy having an opportunity to work on a project for an extended period of time. As with most of the club program, children were given choices from a range of activities that have been done previously in the STEM Club program and children were challenged with making the activities and the learning experiences their own. Children were also grouped in such a way as to promote the development of skills and support productive project work. The challenges of navigating such organization were described by one STEM Club staffer:

> ***Initially I was nervous– I was very nervous, because putting on a showcase like that takes a lot of time. Beyond the setup in the back end, getting the participants to a place where they're ready to not just put on a show, but also understand what they're saying. Being able to field questions, being able to even build something for a guest on the spot does take quite a bit. And we did take the care to tailor our preparation sessions so that they'd be learning the skills to work with each other. And, as well, to effectively put on a presentation and then to effectively be able to answer a question that they weren't prepared for … and then another big, big thing to be careful of was the grouping. Who will be together, not so much for the sense of these two are going to butt heads and these two may not enjoy working together and blah, blah, blah. But more in the sense of what groups can actually thrive best and which groups would actually benefit the most from having this person who displays the leadership quality to a high level. This person who's highly resilient, this person who is a team player and can hash things out. It pulled a lot from and it was informed by our STEM skills charts.***
>
> (STEM Club staffer, individual interview)

Children also made note of the fun they had at the science centre when given an opportunity to explore and follow their own interests (alongside a STEM Club staffer) rather than being guided by a strict schedule (as often happens on school visits). Children indicated that, since they were not invited to participate as presenters at the Expo, they were not very interested in watching the presentations of the other STEM Clubs.

Scheduling activities within and for the local community

It was heart-warming to hear children speaking about how they had engaged their friends and relatives in talk about the STEM Club. Indeed, younger and older siblings and other relatives often arrived at the club space at the beginning or end of the session, interacting with staffers and other children in the club. Although the parental pick-up location was away from the club space, staffers were able to chat with parents/guardians each week at pick-up time or when parents/guardians wandered down to the club space for early pick-up. As one STEM Club staffer explained:

> ***And then a lot of the times too it [club influence] will spill over to even their peers, their siblings. We had a lot of siblings that would come to the clubs like after hours as we were getting ready to leave and they'd say "oh hey, you did this" and then like "can I try that?" And then we would just do it for them really quickly and then they'd have something to take home for the day. The impact that it's had even on them too is phenomenal.***
>
> (STEM Club staffer, individual interview)

Teachers also explained how pleased they were to see the club activities spilled over into the school context:

> ***Teacher 1:*** ***They get to stay later at school, and they get to do cool fun things***
> ***Teacher 2:*** ***Yeah***
> ***Teacher 1:*** ***And then they bring them the next day and they get to show their friends those cool things they made or talk about the cool experiments they did. It was just generally desirable, widely desirable. I had much more than half of my class wanted to come. And hadn't had the opportunity***
>
> (Teacher Focus Group)

In addition to sharing with classmates who were unable to attend the club, teachers explained that the children were also keen to share with them what they were learning:

> ***Teacher 1:*** ***There was overlap with the curriculum, at least for what I was doing with the Grade 5s. So, we got to do something and we had in class experiments and the immediate reaction was: "We did this at STEM!"***
> ***Interviewer:*** ***So, it was useful to have that overlap or…?***
> ***Teacher 1:*** ***They kind of became my classroom experts on it. They knew what to do, because they have already done it at STEM and so they could help the other students making my job easier, because they being the assistants to the others and being the experts. And the opportunity for them to share their expertise and knowledge and that is invaluable as an esteem booster for them. So, having that overlap, I thought, was a great thing, so they didn't mind that they had already done it***
>
> (Teacher Focus Group)

The culminating event of the club year was the showcase to which the children's teachers, support workers, peers (school students), and parents/guardians were invited. This event represented a real landmark in the club's calendar. The children described, with excitement, the involvement of their relatives in showcase activities, particularly in making the slime, including details of the multiple attempts that adult relatives had made at making the slime and the details of how they interacted with the slime:

> ***Interviewer:*** ***Did your parents come, to the showcase?***
> ***Teresa:*** ***Not mine***
> ***Rose:*** ***Yes, mine did***
> ***Nicholas:*** ***Mine did***
> ***Rose:*** ***Mine did***
> ***Interviewer:*** ***How was it?***
> ***Teresa:*** ***My aunt came***
> ***Interviewer:*** ***Your aunt?***
> ***Teresa:*** ***Yeah [background conversation about two children in the club who are related]***

Interviewer: ***Oh, that's nice. Did they enjoy coming?***
Rose: ***Sure!***
Teresa: ***… At the end, my aunt was making slime, I told her that she could take it out and play with it, but she didn't want***
Rose: ***My mum did***
Interviewer: ***Oh, really?***
Rose: ***"Oh my Gosh, it's too sticky", she said like, "can I get another one that is less sticky?" And I made her one that was harder and she went like this [gesturing] and she said: "I like this one, this is way better".***
Nicholas: ***Slime is supposed to be sticky!***

(Children's Focus Group 1)

The fact that more than 16 adults attended the showcase (a final count was not conducted) indicates just how invested parents/guardians were in their children's STEM Club experiences. The children were very excited to have their parents/guardians witnessing them demonstrating their STEM Club project and a number of adults were videoing their children as they presented, often adding directions such as "speak up!" or "slow down". One parent/guardian commented that their child had asked him to come to the club with them; when asked what he thought of that, he said that it might be a good idea. He said that the experience had been so positive for his child and kept repeating that "all of this is really good for them". It might be possible to envisage opportunities where children and relatives could work alongside each other in the club; such a 'family fun day' might present opportunities for club staffers to connect with the children and parents/guardians and siblings together. As explained by one of the teachers, the school seemed to be an ideal space to expand some of these activities into the broader community:

Teacher 1: ***This is a community where a lot of the parents love to have the additional opportunities for their kids***
Teacher 2: ***And in a safe spot***
Teacher 1: ***Yes, they know the school is safe***

(Teacher Focus Group)

Many of the children complained about the club ending before the end of the school year and blamed the principal for finishing the club in April. Even though the principal explained that the schedule was set by Visions of Science, the children were still upset. This was captured in the exchange between children of focus group 1:

Rose: ***OK, there is this one, one thing I don't like about STEM, it's why you have to leave.***
Teresa: ***Exactly***
Interviewer: ***You mean, now that it's over?***
Teresa: ***Like, why can't it be for the whole year?***
Nicholas: ***Why can't we just come– can we do it like Monday, Tuesday, Wednesday …***
Interviewer: ***You would like to have it like every day?***
Nicholas: ***Yeah***
Rose: ***Yeah***
Teresa: ***Yes***
Interviewer: ***We can tell them about that, because that's why we are asking, because …***
Rose: ***I'm not even going to be here next year***
Interviewer: ***You are not going to be there?***

Rose: ***You go to Grade 5, I'm going to be to Grade 6***
Teresa: ***Can you guys come to– Can you come to [name of a local school]?***

(Children's Focus Group 1)

It may be important for parents/guardians to have a fixed schedule for afterschool supervision of children throughout the school year. Ending the club before the end of the school year means that alternative arrangements had to be made for the children on Mondays for the 7 or 8 weeks that remained in the school year. That being said, being a little bit out of step with the school year did make the club distinct from regular school activities and left the children wanting more.

Sometimes opportunities for community-building were overlooked due to the busy-ness of running the club. An example of one such opportunity was the pajama day that the school had scheduled for one of the Monday's when the club was in operation. Even though club staffers may have decided that they would not necessarily participate in the dress-up event (given that a few of the children in the club were not participating), it would have been nice for the club to be aware of events in the school calendar that could present opportunities for closer connection to the community.

Examining the place of STEM terminology

It is clear that the STEM Club was doing so much more than STEM education in the Prairie Lane community. The intent of the program is to use STEM as a vehicle that raises familiarity and comfort with science-related material for children who are often marginalized from STEM career fields, while contributing to other important life attributes such as leadership development and enhancing social-emotional learning. Teachers described how children seem to have grown in confidence and leadership capacity through their experiences in the club:

Teacher 1: ***[One child] is my top academic student. She is, like, head and shoulders above the other kids in the class, this close [gesturing] to gifted, I think. She is somebody who probably needs to own her leadership skills, and that might have been a good opportunity for her to do that***
Teacher 2: ***Yeah***
Interviewer: ***Right***
Teacher 1: ***So, even if they are not getting the academic booster, they are getting the leadership practice, that she needs too.***

(Teacher Focus Group)

One of the teachers went on to explain that, as a school, they were not worried about how academic the club was; once the engagement was fostered, the school teachers were well equipped to develop the academic side of the learning that the children were doing in the club. Again, this reinforced the complementarity of the club and school, working in partnership for the holistic development of the child. When focusing on the specifics of the various STEM topics addressed, STEM Club staffers were more interested in getting the engagement locked in before being concerned with the precise scientific terminology. This idea was well captured by one of the STEM Club staffers who explained:

> ***Examining the place of STEM terminology specifically. It is important to know what is the name given to 'this', because that's just how the transfer of knowledge works, you would need to be able to communicate. However, understanding a concept takes you a lot further than just knowing the buzzwords or keywords of certain things. And maybe you may not know how to describe– what's the specific jargon for this, if you can do the process, then you know that's really the important piece. All that other stuff– Those little things would***

> ***come afterwards and they will come naturally, they will flow naturally. Be it through questions or be it through experimentation. And at least I can say that initially that focus didn't need to be there, because it did come in afterwards. It did come in afterwards with "what do you call this, what is the name for that, like what does it tie to in the real world and people's jobs and then what would they call it?" All stemming from, you know, their interest in the topic.***
>
> (STEM Club staffer, individual interview)

That being said, it would have been nice to see a more explicit articulation of the club's ethos and goals shared with the children, this would include a description of the way the club views STEM and how that connects with what would be required for children to do well in school science. Nevertheless, we saw numerous examples of children exhibiting a scientific curiosity and asking excellent questions that demonstrated how interested they were in what they were experiencing. We wonder if there would be scope for children to conduct self-discovery research and discuss their findings rather than relying on the leaders as the sources of knowledge. This could be facilitated by having an Internet-connected tablet (or similar device) available, to which staffers could give children access when they have scientific questions of interest to explore.

We also saw that children took pride in wearing the club t-shirt during the showcase event and we wondered if this could be used for each club session for the dual purpose of protecting the children's school clothes (given that a number of children were very concerned about their parents' potential responses to their school clothes being messy right at the start of the week) and helping to assert a club identity for the children as they conduct the activities and move through the school at the end of each session.

The STEM Club was a unique and invaluable space for the children who attended. The enthusiasm and dedication of the staffers was supported and endorsed by school and home community members, forming a treasured resource that was an important contribution to the Prairie Lane community.

IMPLICATIONS AND RECOMMENDATIONS SUMMARY

The findings of this report have been summarized in Table 2 below.

Table 2. Summary of study findings

Objective	Implementation Strategy	Challenges	Suggestions for Future Development
Exploring partnerships with community organizations	Club located in a school at the end of the school day. Permits were coordinated with the school principal's endorsement.	Teachers and staffers often overlapped in their dealings with the children such that demarcation of jurisdictions was sometimes blurred. Connections outside of the school context were restricted to existing partnerships: science centre and visiting scientist group.	The parameters of school and club interaction could be explored with the principal before the club is established for the year, with STEM Club staffers being intentional about how, why, and under what circumstances interaction with teachers and other community members may be supportive to the overall mission of the club in the community. As comfort levels build with the school setting, STEM club staffers (alongside community members) could explore science connections with other community organizations with which children may have familiarity (such as Parks, Forestry and Recreation – City of Toronto). STEM Club staffers could liaise with these local organizations to design activities for the children. Children could be encouraged to think about what questions they have about the work of the organization before activities are planned.
Recognizing community funds of knowledge	Phase 1 of the study sought input from teachers, community leaders, and children about community resources, wants, and needs.	While establishing the new club there was not much time or space to develop relationships and incorporate local knowledge.	STEM Club staffers could continue to build relationships with home and school community members who have connections with science, involving them in session activities on designated community guest days.
Exploring contemporary approaches to science education	Self-directed inquiry was the focal point of activities for the new club, culminating in a showcase event. Outdoor activities were play-based and illustrated the potential for incorporating science connections.	Since outdoor spaces have not always been a feature of STEM Club settings, place-based modules are yet to be developed but children have indicated that such approaches might be welcome.	There is still much potential for inclusion of place-based strategies that could promote scientific literacy, scientific citizenship, and/or science for action. Energy audits and learning trails are ways to support children in developing a connection with their environment as well as a sense of care for their immediate community. There is scope to push the inquiry approach further to explore child-initiated inquiry.
Exposure to primary research in science education	Outside of the literature introduced in the study's interim report, there was little evidence of STEM Club staffers exploring literature related to community-based science programs. However, the experimental club itself	This aspect was not prioritized in the first iteration of the community-responsive club but could be developed later down the line.	Developing opportunities for leaders and staffers to interact and discuss the relevance of various lines of published research can keep the program fresh, supporting staffers in adapting to local needs; this will allow the club to continue use of the theory-into-practice approach.

Objective	Implementation Strategy	Challenges	Suggestions for Future Development
	was a great example of ways of exploring how research theory can be put into practice.		
Supporting the diversity of children's interests	Topics that are popular with children, or 'socially trending' were often picked up in the club activities. Children had opportunities to view photos of previous club activities and projects from which they could develop ideas for their own showcase projects.	It is difficult for children to articulate exactly what they enjoy and what they don't enjoy until they have some experience or some ideas presented to them. Now that the children have some ideas about what is possible in the club context, they may have more ideas about the kinds of things they would like to explore.	Individual interviews (potentially, in the style of the statement-sorting exercise described in this report) could be used to initially gauge children's expectations and interests. Flexibility with programming will develop as familiarity with the children and the context develop. Input from parents/guardians, teachers, and siblings might also provide some data about interests. Ad-hoc interests and questions could be explored by children if dedicated Internet-enabled devices were available for emergent research.
Scheduling activities within and for the local community	A showcase event was run within the school where teachers, children (peers of club members), and family members could attend. The award ceremony at the end of this session was a great way to end the club year.	There were some acoustic and organizational issues in the space selected by the school to house the showcase but reports were overwhelmingly positive about the children's performances at the event.	Many suggestions were made by teachers regarding the potential role of children as STEM ambassadors in the school and alternative models to the 'scientists in school' that the STEM Club staffers could facilitate. Having an awareness of the school calendar may support STEM Club staffers in their integration into the children's community. There is scope for 'family fun' club sessions to connect the home, school, and club communities for the children.
Examining the place of STEM terminology	Each session, the main activity was based on one or more of the STEM subjects. 'STEM skills' of leadership, teamwork, and resilience were explicitly nurtured by the club.	It was often difficult to discern an explicit articulation by STEM Club staffers of the position of STEM in the lives of the children and there were difficulties in defining the parameters of the club space. At times, the club's identity tended to merge into the school's identity.	Having a distinct articulation of club goals and aims for the children could support development of a clearer definition of the STEM Club (and STEM) for the child. Science-related skills such as research, creativity, and tenacity could be added to the skills chart to incorporate subject-specific STEM attributes. STEM Club staffers could consider using t-shirts to help reinforce the club identity as being in collaboration with but distinct from the school.

MODELLING COMMUNITY-RESPONSIVE SCIENCE CLUB PROGRAMMING

Figure 14 identifies a summary of the key features of community-responsive science club programming that were determined by this study. These features are depicted in a cyclic model illustrated in Figure 15. The interconnection of home, school and club contexts is highlighted as nurturing the science education of the child and a role for future iterations of research has been identified. In the case of this study, the research component was conducted by our team at the University of Toronto but it could feasibly be conducted by a research team designated by the club providers.

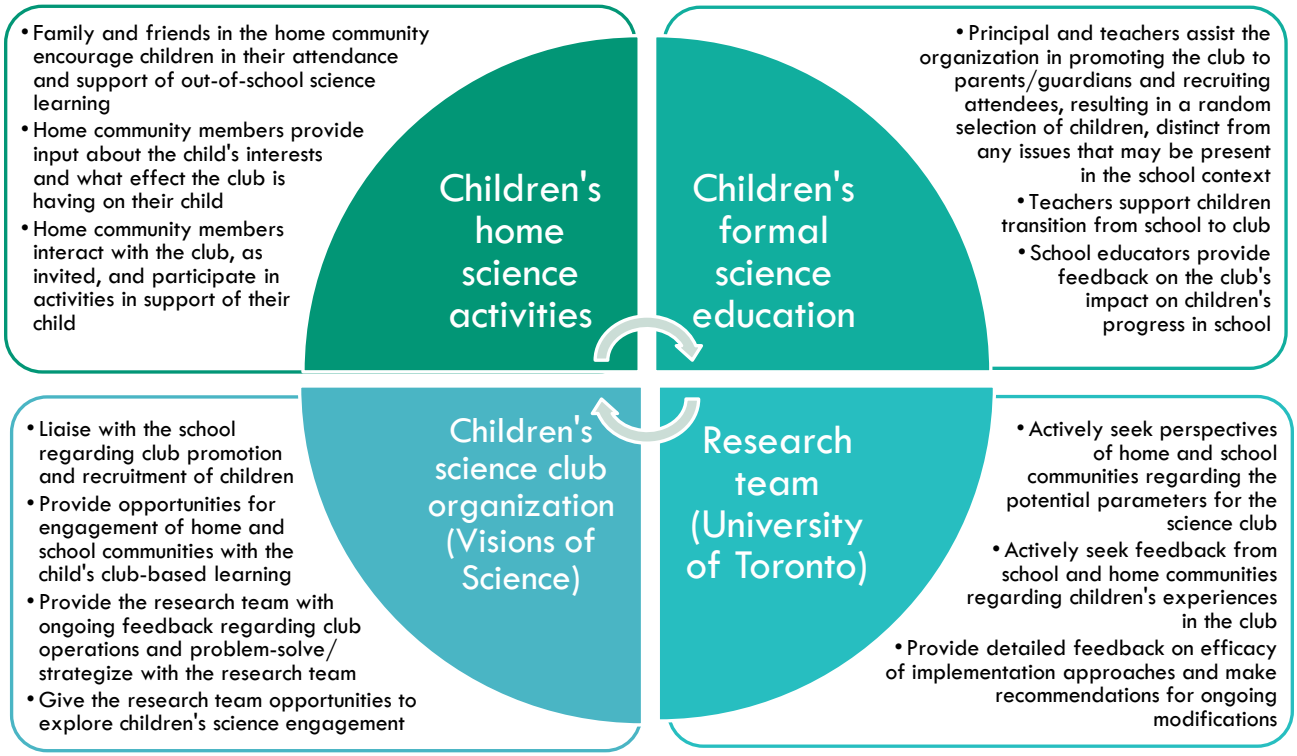

Figure 14. Key elements of community-responsive science club programming.

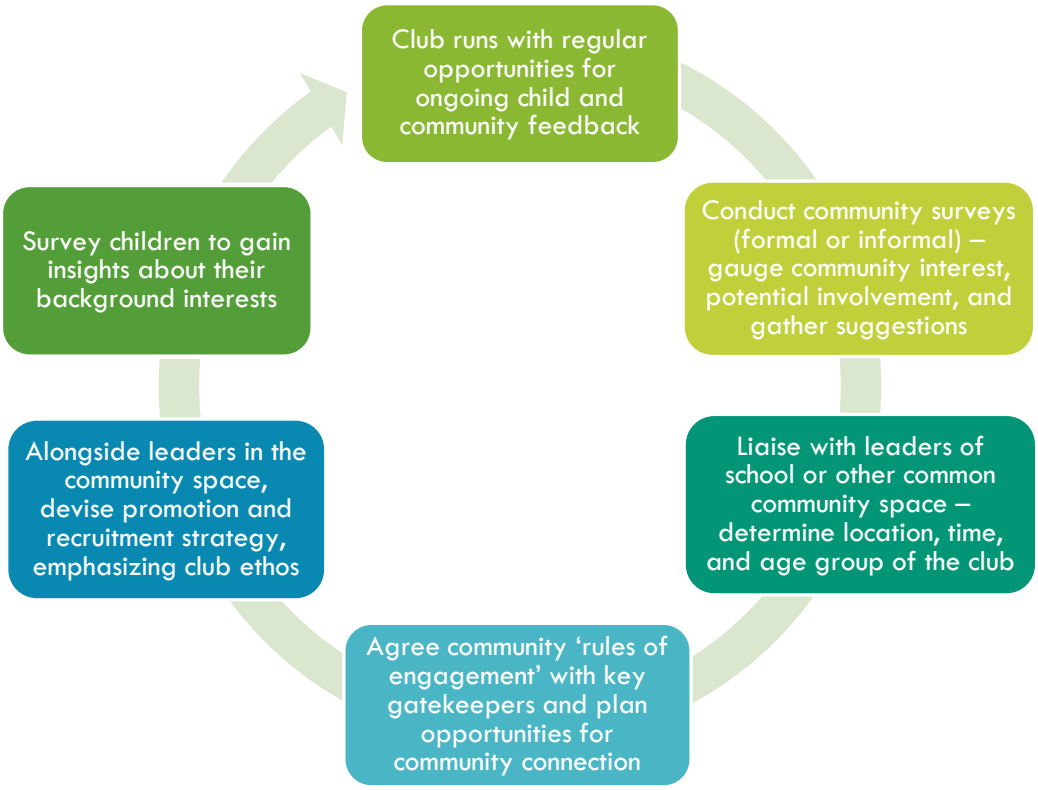

Figure 15. Simplified cyclic model of community-responsive science club programming.

APPENDIX: ADDITIONAL COMMENTS ABOUT THE CLUB'S IMPACT ON THE CHILDREN AND THE SCHOOL COMMUNITY

Children

One of my favourite things in STEM was, like, doing activities with the teachers [club staffers], talking … and making, like, the volcanos. We were making slime and all of that. There was a good opportunity for us just because we got extra work but it was more fun.

(Henri, Children's Focus Group 2)

Three things: first thing is that it was fun, the second thing I was excited, third thing it was like you made– like when you made a thing, it was like a trip that you had to come on that day … It was like an important thing to do so you had to come that day.

(Danny, Children's Focus Group 2)

For me like what I did, I thought it was something like, for example, like basketball practice, you know that you just want to go, because you are interested in something, for example, if you are interested in science and you come late, what happens when your first day of STEM, you come, "Okay, that is fun" and after, the next Monday when you sleep and you wake up, you are like "Oh, yeah! I have STEM!"

(Henri, Children's Focus Group 2)

[When] we have science [class], it's like "why does science even exist?", but when we come to STEM it's like: "Oh my Gosh, I love science!"

(Rose, Children's Focus Group 1)

I totally did it. I first thought science was just like a boring thing. Albert Einstein was just basically doing math all of a sudden … And now I think science is like the best, it's like the fun thing, it's like a fun thing better than video games, better than everything. It could make your life change, basically.

(Danny, Children's Focus Group 2)

I know a lot about science experiments now I can do at home.

(Wanda, Children's Focus Group 2)

It makes you feel, when you do something– it actually makes you feel like you actually succeeded. Before, like, oh yeah, for example, you had a water bottle with hot water and there is ice, lots of ice around it, and then after the bottle starts crushing down, and then after we were like: "Oh, yay, we did it!" but now, after STEM, we actually feel like we had a talent– or like– It makes you feel better?

(Henri, Children's Focus Group 2)

You know what I liked? I liked everything, all the activities we did.

(Rose, Children's Focus Group 1)

It's exactly the same thing. Like, you know the science project? We had this science thing, in the class. My friends wanted to do a light bulb, and how it works. They didn't know how to do it. But I did!

(Elsa, Children's Focus Group 2)

School Principal and Teachers

The STEM program, it's hands-on, it's how kids learn, you know, the children have an interest in it.

(School principal, individual interview)

I knew that, "Oh, well, this is a great opportunity, the Board's talking about STEM a lot," and I said, "You know, if this is a way to get our students involved, it would be great." And then, [the students] came back, every week they were pumped, and they were talking about it in their classrooms.

(School principal, individual interview)

But I know that the children, on a whole, appreciated the opportunity, and they enjoyed the program. So, you never know, we'll get some scientists out of this, you just never know! You never– you know, down the future how this program, you know– they get a snack, which is awesome. It's great! You know, they look forward to attending the session, and that's– for us, that's great, because, you know, we don't always have staff to do these things after hours, 'cause it would be on a voluntary basis.

(School principal, individual interview)

After week one, I could hear the buzz from the students and them talking about it and talking to their teachers, and the teachers would say, "Okay, we're going to try that experiment in the classroom." So, I didn't have any apprehensions about the program. I knew that it was a wonderful opportunity for our students, I was just happy that we were able to facilitate by providing the space, and we were able to get the parents onboard, and I guess the rest is history.

(School principal, individual interview)

… our students benefited, so, it's awesome, you know. I wish we had more opportunities that we could offer our parents and our children, but this is a great start. So, I'm hoping that, you know, there'll be some funding that they can continue here at [the school] next year, because I know that they will have students participating.

(School principal, individual interview)

And the children wanted to be a part of it. We've got very bright kids here, very, very bright kids, even, you know, there was a student who the teacher said, "I'm not sure [principal], 'cause he's not going to– he doesn't do much in class", but he wanted to go to the STEM program, and he did! You know? It's hands-on. You know? It's science, it's inquiry-based, you know? So, that's how our children are learning, right?

(School principal, individual interview)

I do like the fact that they are able to talk about things a little more, and talk about what they are wondering about, which is a really big thing, you know, because when we're talking about it, I sometimes I used to feel that, you know, I'm just talking to them … You know? But now, you know, especially [name of a child] she's been asking more questions. Yeah, she is like, "I wonder…" Yeah, more questioning, curious, curiosity, yeah …

(Teacher, Teacher Focus Group)

… because they [parents/guardians] signed the paper, they got them there and never once did I hear a negative thing from any parent about it, and they were happy that their kids were in it.

(Teacher, Teacher Focus Group)

… like I said before, it was extremely positive, because they did feel like they were experts and could share some of that knowledge and that was good for their esteem-building and leadership

(Teacher, Teacher Focus Group)

They love the hands-on and they love cool experiments. And, they love extra-curricular. They love doing something at school that is not school, and yet still is school. If you understand what I mean

(Teacher, Teacher Focus Group)

They have to be able to see themselves as scientists and it's hard to see yourself as a scientist when all your scientist role models aren't anybody like you, in any way … umm … whether it's gender, whether it is you know racial, it's great to say: "Hey, I'm a scientist like this person is a scientist" and, you know, because we are alike in so many ways … umm… I think that, yeah, I agree with you [another teacher] that this invaluable, absolutely valuable, for the community that the role models have to be something that reflects the community.

(Teacher, Teacher Focus Group)

Especially with gender, because we lose these girls, you know, once they get to high school, you often lose these girls, because science is not looked at as being the realm of that gender … and that is so wrong because right now my top math and science students are all girls, they are the top. And why, all of a sudden, they don't stay the top? They need to be encouraged to stay there. And, I think, part of what I really liked about this program, is that, I mean, it is my own philosophy, that at this age it matters less the content than that affect, because if you could impress upon these kids that science is fun and fascinating, then you won. You've won, because the content will take care of itself, as long as they are motivated. I found this program, extremely motivating for the kids, with respect to science

(Teacher, Teacher Focus Group)

… the work that you are doing is just so important. A lot of these children don't have or just don't know where to get access to these things, right?

(Teacher, Teacher Focus Group)

Teacher 2: *… having those programs in school really does make them accessible for the kids and they just, they see it*
Teacher 1: *It also makes it easier on the parents.*
Teacher 2: *Yeah, on the parents, it just gives them peace of mind.*

(Teacher Focus Group)