STEM Beyond School Year 2:

Accomplishments and Challenges

An Evaluation Report Prepared for the OSU Extension 4-H and Portland Metro STEM Partnership Team

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Executive Summary

The Center for Research on Lifelong STEM Learning was invited by the Oregon State University Extension Service 4-H Youth Development and the Portland Metro STEM Partnership to evaluate Year 2 of the STEM Beyond School (SBS) project. The STEM Beyond School project seeks to improve underserved youth's access to and interest in STEM learning through 1) the development of a statewide network of out-of-school providers focused on STEM learning opportunities, 2) building capacity of out-of-school providers to deliver effective STEM programming, and 3) delivering high dose programming to underserved youth. The Center evaluated the impact of the second year of programming on several youth outcomes (attitude towards learning, persistence in solving problems, active engagement with science, connection with and enjoyment in the program itself, and attitude toward science including whether they can succeed in science), assessed the type and quality of programming offered to youth, and analyzed the development of a state-wide network that supports out-of-school learning. In its second year, the SBS project continued to focus on collecting data that would address outcomes of the project and inform the development and maintenance of a sustainable infrastructure that would support a Networked Learning Community of community-based STEM education providers.

This report draws from various data collection methods to provide insights into the development of the STEM Beyond School network and the potential impact of out-of-school programming on youth's learner identity and associated factors which contribute to the development of interest in STEM and STEM learning. Data were collected from SBS program providers, and youth participants through online and paper-based surveys; interviews with program providers; and reporting workbooks and post-program surveys completed by program providers.

Data indicate that investments into the SBS system and professional development and youth programming by the state continue to be instrumental in fostering and strengthening a growing network of effective and impactful out-of-school STEM programs. In general, program providers felt supported through a sufficient amount of collaborative learning opportunities. The SBS project served 907 youth in 2017/2018 through interactive and engaging activities, experiments and field trips focused on a wide range of topics. Youth on average entered the program with already strong science interest and identity which they maintained over the course of the program. In addition, those youth who entered with lower initial scores reported significant increases in identity-related outcomes across all six measures. These results indicate that the programs may be able to develop new STEM identities as well as support well-developed STEM learners along their already chosen path. Youth also shared a wide range of experiences they valued about the programs, including opportunities to engage with science and engineering activities, experiments, and field trips, as well as other aspects unique to out-of-school programming such as a space to safely express themselves, make choices about their learning and receive support from instructors who encouraged them to grow intellectually and personally, which are core components in development of identity. Based on empirical findings, the report provides recommendations for improvements and future

iterations of the SBS project, including: continued program support, experimenting with measures of student cognitive gains, and supporting additional face-to-face meetings to encourage network development and sustainability.

Key Findings in Detail

Program quality

- In the second year of the SBS project, participating institutions continued to develop and implement diverse, engaging and highly interactive out-of-school STEM opportunities for underserved youth. As a result, over 900 youth participated in STEM programming and field trips which they had otherwise not experienced during the funding period.
- Programs involved in the SBS project provided a wide range of opportunities for youth to engage in interactive, student-centered, applied learning, especially in the Math and Science/Engineering content that is aligned to NGSS practices. Most programs focused on engaging their students in two or more practices with the majority focusing on engaging students in designing, testing, & redesigning their own engineering solution, followed by designing and asking questions about the world around them. Not only did youth in the programs supported by SBS get to engage in the interactive, student-centered applied learning aligned to NGSS practices, they engaged with many of them often or every session/almost every session.
- The majority of programs focused on two of the 4 Core Programming Areas: "Students as Do'ers and Designers" and "Youth Interests Drive Programming." Only one program focused on helping youth apply their learning to new situations.

Youth Outcomes

- The SBS project served a total of 907 youth statewide, with 87% combined disadvantaged (based on 638 participants for whom we could obtain data). On average, these youth participated in 52 hours of STEM programming.
- Based on pre- and post-survey scores, on average, youth participating in the SBS Program maintained their STEM identity and motivational resilience over time.
- Similar to results in Year One of the project, the youth who began the program with low scores for youth affective outcomes in the pre-survey significantly increased in all measures, indicating that initially low-interest youth became more interested and engaged in STEM over the course of the year, although their post-survey scores were still at a weak to moderate level.
- However, youth who began the program with moderate to high scores for youth affective outcomes reported either no change or significant decreases for some measures. This outcome should be interpreted cautiously because unchanging or mildly declining pre-post attitudinal or dispositional measures can be due to the statistical

phenomenon called the ceiling effect (and associated "regression to the mean") rather than a functionally significant change in youth attitudes or motivation.

- Youth outcomes did not differ on the basis of race/ethnicity or gender. In addition, the number of hours youth participated in STEM programming did not significantly influence outcomes.
- Motivation to participate in the program appeared to influence youth outcomes. For example, youth in the initially low-scoring group were significantly more likely to have participated in order to have fun or because they were compelled by parents or others to attend, rather than due to an existing interest in STEM; that is, when students participated for reasons unrelated to the topic, they were also more likely to score low on initial measures. However, they were then also more likely to improve on these measures over the course of the program.
- Youth valued not only the opportunities to engage with science and engineering activities, experiments, and field trips, but also the opportunity to make friends, feel like they belong, safely express themselves, and receive support from instructors who encouraged them to grow intellectually and personally. In addition to these affective outcomes, some youth (16%) reported that they valued the learning that took place in these programs, indicating that there were likely important cognitive outcomes as well. Note that creating or measuring cognitive outcomes were not foci of the project in Years 1 or 2, hence we did not assess them.

Network

- The majority of program providers agreed that the SBS network fostered idea sharing and mutual learning and was a valuable aspect of the SBS project. In general, in-person meetings, which were viewed as prime opportunities for relationship building, were seen as most valuable and impactful, followed by Learning Communities and webinars.
- Nearly all participants were able to provide an example of a new relationship they developed as a result of SBS, or an existing relationship that was strengthened through the program.

Development and modification of the evaluation system and research tools

- Most of the development of research tools and assessment measures took place in Year 1 of SBS. Therefore, this year focused on refinement and/or modification as necessary.
- We retained the seven affective scales from last year's post-survey which continued to provide acceptable measures of the program outcomes (see appendix for reliabilities associated with each measure). The survey was only slightly modified to include a question about youth motivation for participating that could be used to segment the sample of responding youth during data analysis.
- We retained most of the questions in the self-assessment tool but reorganized it to make clearer ties to the 4 Core Programming Areas. We also developed a short online post survey for program providers to self-report characteristics of their programming.

STEM Beyond School: The Context

Why is STEM Beyond School Needed?

Youth in under-resourced communities across the state have significantly fewer opportunities to connect to STEM learning than their more advantaged peers. This uneven approach fails to ensure that youth are developing their skills, abilities, and dispositions in STEM, and as a result, may not seek opportunities in Oregon's future STEM workforce and economy. STEM Beyond School was established to address this problem by focusing on two critical aspects: providing high quality STEM learning experiences to youth now, and creating a supportive infrastructure for community-based programs to continually improve and expand to reach more youth over time.

What are the Goals of STEM Beyond School?

STEM Beyond School was designed to support existing community-based programs to provide high quality STEM experiences to youth across the state. This out-of-school and predominantly off-school grounds project stipulated that participating youth in grades 3 through 8 engaged with a minimum of five different STEM experiences located in their communities and supported by highly relevant field experiences. Programs were required to provide at least 50 hours of learning connected to the interests of their youth that followed the 4 Core Programming Areas of SBS (student driven, students as do'ers and designers, students apply learning in new situations, relevant to students and community-based). For comparison, elementary students in Oregon receive 1.9 hours per week of science instruction (Blank 2012). SBS was therefore a targeted investment towards dramatically increasing meaningful STEM experiences for underserved youth while also advancing the capacity of program providers to design and deliver high quality STEM activities for youth that center around learning in and from the community.

STEM Beyond School requires programs to intentionally engage historically underserved youth, specifically youth from communities of color and low-income communities as well as youth with disabilities and those who are English-language learners. With a grant requirement of engaging at least 70% participation amongst these groups, programs were challenged and inspired to rethink their traditional ways of reaching out, recruiting, and retaining those students. In Year 2, STEM Beyond School reached approximately 907 students in total. For the 638 youth for which we were able to obtain data, 87% were considered disadvantaged by ODE categorization.

To ensure long-term benefits for youth, STEM Beyond School provided capacity building support to the community-based programs in the form of educator professional development, program design guidance, a community of practice for participating providers, and equipment. Educators working directly with youth participated in high quality, high dose (40 hours for new providers and 30 hours for returning providers) professional development connected directly

to their specific needs. Professional development categories included essential attributes in program quality, best practices in STEM learning environments, fostering STEM Identity, and connecting to the community. Rather than providing one-size-fits-all workshops, the program crowdsourced the needs of the educators and then leveraged expertise from across the state to address specific training or coaching needs. This created a community- and peer-based "just-in-time" professional learning experience that allowed educators to modify their programming in real time.

Based in ample research evidence that providing one-time professional development and support is not sufficient to support ongoing program improvement, STEM Beyond School established an infrastructure within various STEM Hub networks to connect programs to each other and a larger body of STEM education experts to learn, collaboratively solve problems, and support innovative efforts. Building on principles from the Community of Practice and Networked Learning Community literature, the project enhanced programming through new regional partnerships and new practitioner relationships leveraged by STEM Hubs. This supported the program's growth as sites used the network as a key resource to share their successes and meet the needs of their students.

Out of School STEM Programs as effective STEM Learning Experiences

In a series of consensus reports, the US National Academy of Sciences has argued consistently that informal or out-of-school science or STEM experiences can be powerful particularly for children and youth from minority groups underserved in STEM. This important finding was first made prominent by the 2009 report *Learning Science in Informal Environments: People, Places and Pursuits* (National Research Council, 2009). In a short policy-oriented consensus report in 2015 entitled *Identifying and Supporting Productive STEM Programs in Out-of-School Settings* (National Research Council, 2015), the National Academies specified basic principles from the research literature that ought to guide the design and implementation of effective out-of-school STEM experiences for youth. This report also introduced the concept of a learning ecosystem as a foundational framework for connected STEM learning across settings and time. The two reports were instrumental in determining the basic requirements for SBS, and also formed the theoretical foundation for youth outcome and program assessment described in this report.

Scope of the Study

This evaluation study examined the collaboration of out-of-school STEM program providers, support organizations, and the SBS Project Partnership Team, their collective impact on youth STEM learning and identities as well as refined the measures and measurement instruments used to both evaluate and improve the STEM Beyond School project into the future. The ultimate goal of this effort, which will be continued in year 3, is to provide specific, data-driven recommendations that will help to strengthen and sustain the positive progress in developing a network of program providers across the state of Oregon. This report is intended to provide insights into the nature of the network that the SBS project sought to establish and the youth who participated in SBS programming. This report in conjunction with the evaluation of the

first year of STEM Beyond School programming ultimately feeds into a broader narrative about the impact and value of out-of-school education. Specifically, we explored a certain set of research questions, and we addressed results from the project for the outcomes presented by the Oregon Department of Education Request for Proposals that led to the STEM Beyond School project.

Research questions

The overarching research question for the summative aspect of the evaluation was simply whether the STEM Beyond School Project was effective. Specific research questions that guided the study included:

1. Did the programs involved in the STEM Beyond School project use effective practices? What was the quality of the STEM programming provided to participating youth?
2. Did the STEM Beyond School project develop an effective statewide network that supports out-of-school STEM learning experiences and continuous improvement and learning?
3. To what degree did intensive out-of-school experiences influence youth attitude towards learning, persistence in solving problems, active engagement with science, connection with and enjoyment in the program itself, and attitude toward science including whether they can succeed in science?

Results

Outcome 1: Increase or maintain student STEM identity and motivational resilience in STEM-related activities.

In total, a diverse group of 907 youth participated in the SBS Program during 2017/18; we were able to obtain demographic data for 638 of these youth (Table 1). However, not all were able to participate in both the pre- and post- survey for a variety of reasons including absenteeism, joining the program late, or non-completion of the program.

Table 1. Demographic composition of youth participating in SBS.

Category	Number of youth	Percentage
Gender		
Female	343	54%
Male	295	46%
Ethnicity		
Asian, not Hispanic	11	2%
Black/African American	19	3%
Hispanic/LatinX	224	35%
White, not Hispanic	312	49%
Native Hawaiian/Pacific Islander	8	1%
Multi-racial, not Hispanic	43	7%
American Indian/Alaskan native	20	3%
Grade		
3-5	336	52%
6-8	306	48%

Note: Demographic data were available for 638 (70%) of participating youth at the time of writing.

Although 683 youth participated in at least one of the surveys, only 305 youth completed both the pre- and post-surveys enabling us to examine changes in a number of outcomes over time associated with SBS programming goals. Youth were asked near the beginning of their programs, and then again near the end of their programs, to rate their agreement with a variety of statements that sought to measure their attitude towards learning, persistence in solving problems, active engagement with science, connection with and enjoyment in the program itself, and attitude toward science including whether they can succeed in science, all aspects that lead to the development of identity and interest in science (See Table 2 for scale definitions and for the full pre- and post-surveys with items and scale descriptions, see the Technical Appendix).

Table 2. Definitions of each scale used in the Pre- and Post-Survey.

Scale	Definition
Learner Identity	Youth see themselves as succeeding in learning and working environments emphasizing science.
Belonging and Relatedness	Youth demonstrate persistence, utilize problem-solving skills and seek help when faced with learning challenges, obstacles, and setbacks.
Purpose and Relevance	Youth demonstrate active participation and interest in science learning.
Competency and Self-Efficacy	Youth feel like they belong in the learning environment, can relate to others and to the topics they are learning within the program.
Constructive Coping and Resilience	Youth believe that learning activities and professional work in science are meaningful, important, and worthwhile.
Cognitive Engagement	Youth believe that they have the capability to succeed in learning opportunities and careers that involve science.
Net Promoter	Youth are satisfied with the program and would recommend it to others.

When we examined all youth who took both the pre- and post-surveys, we found that there was not a significant change in youths' answers over time (Table 3). *That is, on average, youth participating in the SBS Program maintained their STEM identity and motivational resilience over time*.

This is not an uncommon outcome for studies of this sort because youth who participate in out-of-school programs are largely self-selected based on their existing interests in STEM. For this sample of youth, the pre-survey scores were already at the higher end of the scale on average indicating that youth overall reported moderate to strong agreement with statements provided to them (see Table 2). When respondents initially score highly on scales like these, they face what is called a "ceiling effect," which is a measurement limitation that decreases the likelihood of detecting positive changes due to the hypothesized influence of the experimental manipulation—in this case, the out-of-school program. When the ceiling effect is present, no conclusions can be drawn regarding the influence of the manipulation for youth as a single group. However, it is possible to segment the sample to identify groups of youth who differ significantly on the basis of pre-survey scores and examine outcomes for each group separately.

Table 3. Mean pre- and post-Student Affective Survey scores for 7 constructs that represent important potential program outcomes for youth (n=305). Refer to technical appendix for items for each scale and Table 2 for definitions.

Scale	Mean (pre)	Mean (post)	Mean change[1]
Learner Identity	3.84	3.84	0.00
Belonging and Relatedness	4.31	4.28	-0.03
Purpose and Relevance	4.14	4.04	-0.10
Competency and Self-Efficacy	3.53	3.51	-0.02
Constructive Coping and Resilience	3.86	3.81	-0.05
Cognitive Engagement	4.12	4.04	-0.08
Net Promoter[2]	8.56	8.44	-0.12

1. Change scores were examined using paired samples t-tests. All change scores were not statistically different from zero (p<.05). [2]Net Promoter was measured on a scale from 1 (Strongly disagree) to 10 (Strongly agree). All other constructs were measured on a scale of 1 (Strongly disagree) to 5 (Strongly agree).

Accounting for the ceiling effect

In Year 1 of SBS, we addressed the ceiling effect by segmenting youth into high- and low-scoring pre-survey groups based on an arbitrary cut-off value of 4.0 for each affective measure on the survey and found significant increases in all measures for initially low-scoring youth. This year we used a statistical test called cluster analysis to identify underlying patterns in the data to segment the youth into groups based on pre-survey scores. Cluster analysis identifies distinct groups from the data based on small within-group and large between-group variance and therefore is a purely empirical method of classification requiring no prior assumptions about the relationships within the data (Gerard, 1957). This process revealed three distinct groups on the basis of pre-survey scores: 1) High scores for all measures (41%); 2) Moderate scores for all measures (41%); and 3) Low scores for all measures (18%) (Table 4). This allowed us to examine whether the ceiling effect potentially masked significant positive outcomes for initially lower-scoring youth.

Table 4. Mean pre-survey scores for all youth who participated in both the pre- and post-survey by cluster group (i.e., matched pairs).

Scale	High	Moderate	Low
Learner Identity	4.50	3.60	2.74
Constructive Coping and Resilience	4.39	3.71	2.85
Cognitive Engagement	4.76	4.04	2.76
Belonging and Relatedness	4.79	4.26	3.23
Purpose and Relevance	4.69	3.40	3.12
Competency and Self-Efficacy	4.45	3.14	2.14
Net Promoter	9.55	8.44	6.60

Note: n=119 for High; n=115 for Medium; n=51 for Low.

Paired t-tests indicated that *youth in the low scoring group reported significant increases in all measures indicating that initially low-interest youth became more interested and engaged in STEM over the course of the program* (Table 5), although the post-survey scores revealed only weak to moderate support for the affective measures. In contrast, youth who reported moderate scores for all measures on the pre-survey showed no change in Learner Identity, Belonging and Relatedness, or Competency and Self-efficacy, but a significant decrease in Constructive Coping and Resilience, Cognitive Engagement, Purpose and Relevance, and Net Promoter. Youth in the high-scoring group reported statistically significant decreases for all measures which would seem to suggest that the program was less successful for youth who entered the program with already strong STEM identities. However, we do not believe this is the case for the following reasons.

First, statistical significance should not be confused with functional significance. A significance test simply assesses the likelihood that the difference in pre- and post-survey scores may have occurred by chance rather than as a result of the intervention (e.g., out-of-school program). However, it does not provide information about the size of the difference, just that the difference exists. In contrast, effect size measures do tell us how large the differences are, ranging from 0 (trivial) to 1 (substantial). In general, initially high or moderate scoring youth had small to medium effect sizes (0.2 to 0.5) associated with the negative changes in scores (Table 5). In other words, the decreases we saw in these groups of youth are considered trivial and are most likely the result of the ceiling effect (see below). In contrast, the effect sizes for initially low-scoring youth were moderate to large (0.6 to 0.8), indicating that the positive

changes in affective measures for these youth represented a substantial change in their identity and motivational resilience over time. In other words, there is evidence that participation in SBS may have helped these youth begin to develop new STEM identities, although post-survey scores still indicated only weak to moderate support for affective measures.

Second, as mentioned earlier, youth who enter a program with well-developed STEM interests already face a ceiling effect because there is little room for increasing their scores. These youth at best can sustain those interests, or even possibly evidence a decrease over time. This appears to be the case for the initially high-scoring youth in the study as described above.

Third, some participants may overestimate their positive judgment at the beginning of the program, and end with a much more stable, realistic and potentially lower rating on many affective or dispositional measures (response-shift bias).

Table 5. Mean change in affective scores for youth in each cluster group who participated in both the pre- and post-survey.

Scale	High	Moderate	Low
Learner Identity	-.10 (.20)	-.11 (.17)	+ .49 (.66)
Constructive Coping and Resilience	-.16 (.32)	-.19 (.26)	+ .54 (.68)
Cognitive Engagement	-.21 (.56)	-.30 (.39)	+ .66 (.74)
Belonging and Relatedness	-.21 (.37)	-.18 (.12)	+ .73 (.71)
Purpose and Relevance	-.23 (.37)	-.21 (.27)	+ .37 (.57)
Competency and Self-Efficacy	-.25 (.44)	-.11 (.12)	+ .73 (.77)
Net Promoter	-.44 (.34)	-.48 (.24)	+ 1.32 (.55)

1. Change scores were examined using paired samples t-tests. All change scores in bold font were found to be statistically significant ($p < .05$). Numbers in parentheses are effect sizes (Cohen's d). Cluster sample sizes: n=119 for High; n=115 for moderate; n=51 for Low.

Relationship of clusters to motivations to participate

The cluster analysis above identified three distinct groups of youth on the basis of pre-survey scores, but it does not provide information about why that pattern exists. We hypothesized that the underlying similarities of youth in each cluster may be related to their motivations for participating in the program. As described earlier, youth who participate in out-of-school

programs are usually, but not always, self-selected based on their existing interests in STEM. Therefore, we included a survey item asking youth to describe why they were participating in the out-of-school program. Youth reported four major reasons for attending these programs: 1) to have fun (22%), 2) because they had a specific interest in STEM (57%), 3) to enhance college and/or career readiness (8%), and 4) they were compelled by parents (13%).

Pre-survey scores on affective STEM measures differed significantly on the basis of youth motivation for participating (Table 6). For example, youth who participated based on an existing interest in STEM or to become college-ready reported significantly higher Learner Identity, Resilience, Cognitive Engagement, and Relevance than those who attended for fun or were compelled. Youth who were compelled to attend felt significantly less Belonging and Relatedness than youth from other motivation groups. Interested youth also reported significantly greater Competency and Self-efficacy than those who participated for fun or were compelled.

Although motivation itself was not a significant predictor of affective outcomes, the motivation variable was significantly related to pre-survey cluster groups (x^2=40.0, p<0.001). Specifically, youth who were motivated by interest or college preparation were significantly more likely to be in the high-scoring pre-survey group. Conversely, youth who were motivated by fun or were compelled to attend were more likely to be included in the moderate- and low-scoring pre-survey groups. Thus it seems that youth motivation was strongly related to cluster group membership (i.e., low, moderate, or high scores on pre-survey) although it did not fully explain the differences between youth in the three clusters.

Table 6. Pre-survey mean scores by motivation to participate in the program.

Scale	Interested	College prep	Fun	Compelled
Learner Identity	3.99	4.18	3.68	3.58
Constructive Coping and Resilience	3.98	4.18	3.61	3.55
Cognitive Engagement	4.31	4.43	3.82	3.49
Belonging and Relatedness	4.40	4.39	4.26	3.38
Purpose and Relevance	4.25	4.54	3.90	3.81
Competency and Self-Efficacy	3.70	3.76	3.28	3.06

Note: Means with different shading are significantly different at p<0.05.

Role of gender in affective outcomes

Considerable research has focused on how STEM attitudes or interest differ for certain demographic groups. For example, many studies have reported gender differences in science and mathematics attitudes or interest beginning in middle school and continuing into high school with girls reporting less positive attitudes about science and participating in fewer relevant out-of-school activities, culminating in fewer girls than boys pursuing further study and careers in STEM (Frenzel, et al., 2010; Greenfield, 1996; Jacobs, Davis-Kean, Bleeker, Eccles, & Malanchuk, 2005). We did not find this pattern in this sample of youth. For the 70% of participants for which we had demographic data, slightly more girls (54%) than boys (46%) participated in SBS programs. There were no differences in pre- or post-survey scores for any measure on the basis of gender. Neither gender reported significant differences in pre- and post-survey measures when examined separately. Finally, the pre-survey clusters contained equal proportions of boys and girls (χ^2=0.77, p=0.681).

Role of race/ethnicity in affective outcomes

Because racial and ethnic identities can also influence STEM identity (Carlone & Johnson, 2007), we examined whether race/ethnicity appeared to be a significant influence on youth affective outcomes over time. Because of small sample sizes, we compared Hispanic youth, White not Hispanic youth, and combined all others into a group composed of Black, Indigenous, and other People of Color. We found no differences in outcomes on the basis of race/ethnicity for this sample of youth.

Role of dosage in affective outcomes

Research suggests that adolescents who receive a higher "STEM dose," particularly advanced/enriched activities, are significantly more likely to achieve high-level STEM accomplishments as adults (e.g., STEM PhDs, STEM occupations) than youth who receive lower STEM doses (Wai et al., 2010). Therefore, we hypothesized that youth who participated in more hours of out-of-school STEM programming (i.e., higher dosage) would be more likely to report increased interest and identity-related outcomes in STEM.

We received dosage information for 465 youth. On average, these youth participated in 52 hours of STEM programming (median=48 hours) and dosage ranged from 1.5 to 266 hours. Of these youth, 153 participated in both the pre- and post-surveys. Although their dosage ranged from 14 to 266 hours, it did not significantly influence outcomes for this sample of youth. That is, youth who participated relatively more frequently in out-of-school STEM programs did not report significantly different affective outcomes than youth who participated less frequently (F=0.41, p=0.662).

Outcome 2: Ensure that students have opportunities to develop a mindset and confidence to envision their future within STEM careers.

Research suggests that the nature of out-of-school programming may significantly influence youths' ability to develop STEM interest and identity which could lead to future involvement in STEM majors and careers (NRC, 2009). For example, it has been shown that connecting

programming to youth interests and basing activities in the local community can significantly support the development of a STEM mindset. Therefore, programs were encouraged to integrate the 4 Core Programming Areas as the foundation of SBS programs:

1. Students are do'ers and designers
2. Activities are place and community based
3. Youth interests drive programming
4. Youth apply their learning to new situations

We examined the extent to which SBS programming focused on these areas, thus offering youth the opportunity to develop a strong STEM identity (Figure 1). A full three-quarters of program providers reported that they focused on "Students are do'ers and designers." Youth engaged in a variety of experiential learning opportunities including designing and programming robots, solving a number of engineering challenges, cooking, making slime, and many other hands-on activities. Providers noted that positioning youth as do'ers and designers increased their interest and engagement and led to higher retention rates in some cases.
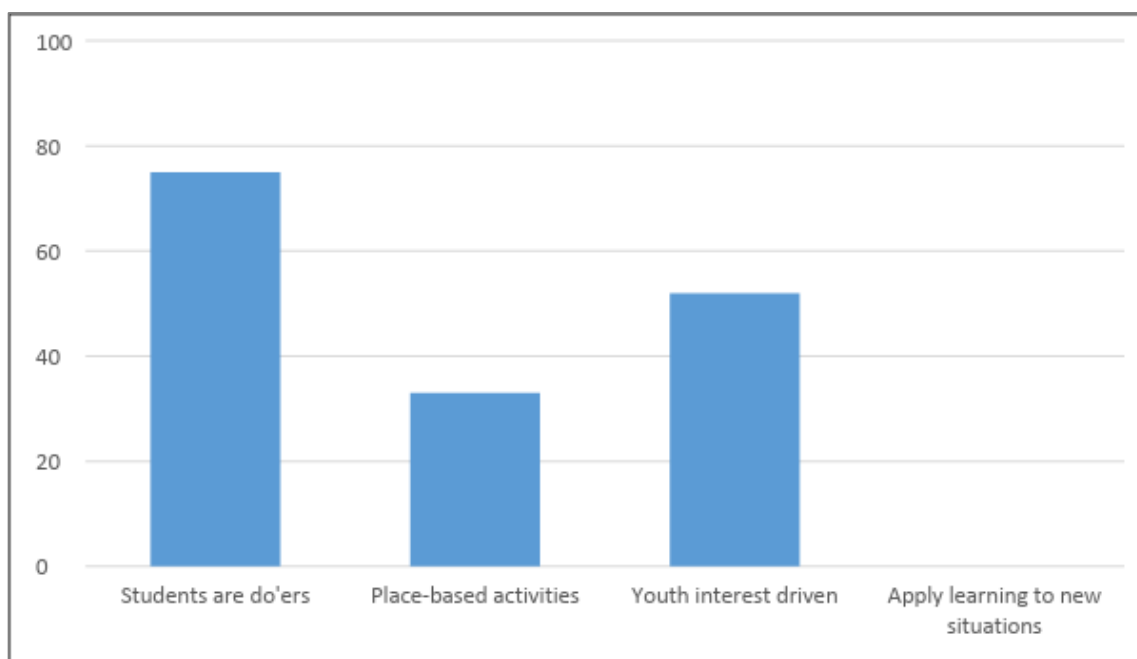
Figure 1. Percentage of program providers focusing on each of the 4 Core Programming Areas. Providers often focused on more than one area, so the percentages total more than 100.

Fewer than half of program providers reported a focus on place and community-based activities. Some observed that in more urban environments, finding suitable locations for place-based activities can be challenging. In the future, program providers should be supported in creating activities that focus on community to increase youth feelings of relevance about STEM in their own lives.

A slight majority of providers (52%) reported that they focused on having youth interest drive the programming that they offered. Although several programs engaged in a formal process such as a survey to determine youth interests, most asked youth informally about their interests and developed activities accordingly. In the future, program providers should be encouraged to attend to youth interest as STEM interest during adolescence is a key factor in persistence (Maltese, Melki, & Wiebke, 2014; Maltese & Tai, 2011).

Finally, only one program reported focusing on providing youth opportunities to apply their learning in new situations. However, most providers reported that they gave youth opportunities to practice skills in similar or novel situations. For example, skills such as scientific sampling were learned in the classroom and later applied in the field. In addition, providers continuously built on concepts that had been learned in previous sessions which reinforced knowledge and skills over time. In the future, this would be an area that would benefit from PD experiences that emphasize the importance of knowledge transfer in the learning process and how to use embedded assessments to examine cognitive outcomes of out-of-school programs.

Outcome 3: Increase opportunities for students to engage in interactive, student-centered, applied learning

Programs involved in the SBS project provided a wide range of opportunities for students to engage in interactive, student-centered, applied learning, especially in the Math and Science/Engineering content that is aligned to NGSS practices that are part of the Oregon standards. We looked at data about the opportunities for students in multiple ways. As part of the exit interview with program providers, we asked which of several practices they focused on the most. Most programs focused on engaging their students in two or more practices with the majority focusing on engaging students in designing, testing, & redesigning their own engineering solution, followed by designing and asking questions about the world around them (Figure 2). One program provider noted that, "Design, test redesign worked the best. The students are interested, engaged and enjoy doing engineering. Especially if it's something they can be challenged with."
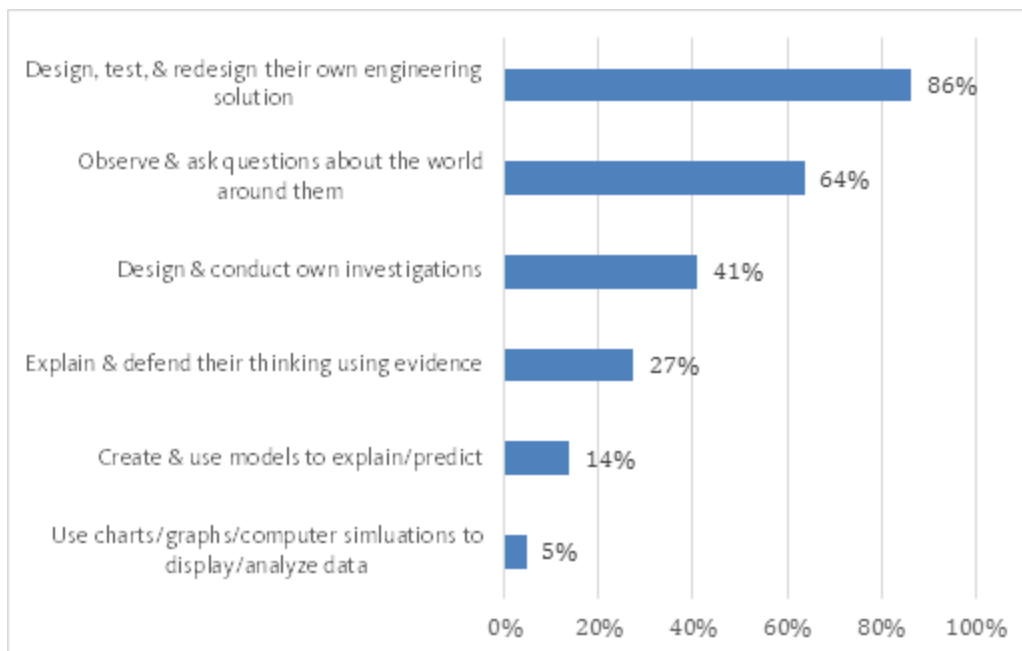
Figure 2. Practices on which programs focused the most out of a close-ended list. Note that several respondents chose more than one practice so the percent totals more than 100%. Twenty-two providers provided relevant information about their programs.

Some examples of the interactive, student-centered applied learning aligned to NGSS practices in which youth were engaged include: programming spheros (small programmable balls) and designing chariots for their sphero to pull; and designing a board based on whether they wanted it to be a rider, cruiser, or trick board and deciding how much it was sanded down for their desired optimal performance. In a third example, youth engaged in cooking as a design, test, redesign project. Youth worked together to make ice cream, and they had to decide how much of each ingredient to use in order to make it turn out the way they wanted.

Programs reported that they focused the least on "use charts/graphs/computer simulations to display/analyze data." Some program providers reported that they focused on engaging youth in the practice of designing, testing, & redesigning because they thought this was a practice that was hard for teachers to dive into in school. On the other end, the two program providers who focused on the "use charts…" practice reported being challenged by this practice being too "school-like."
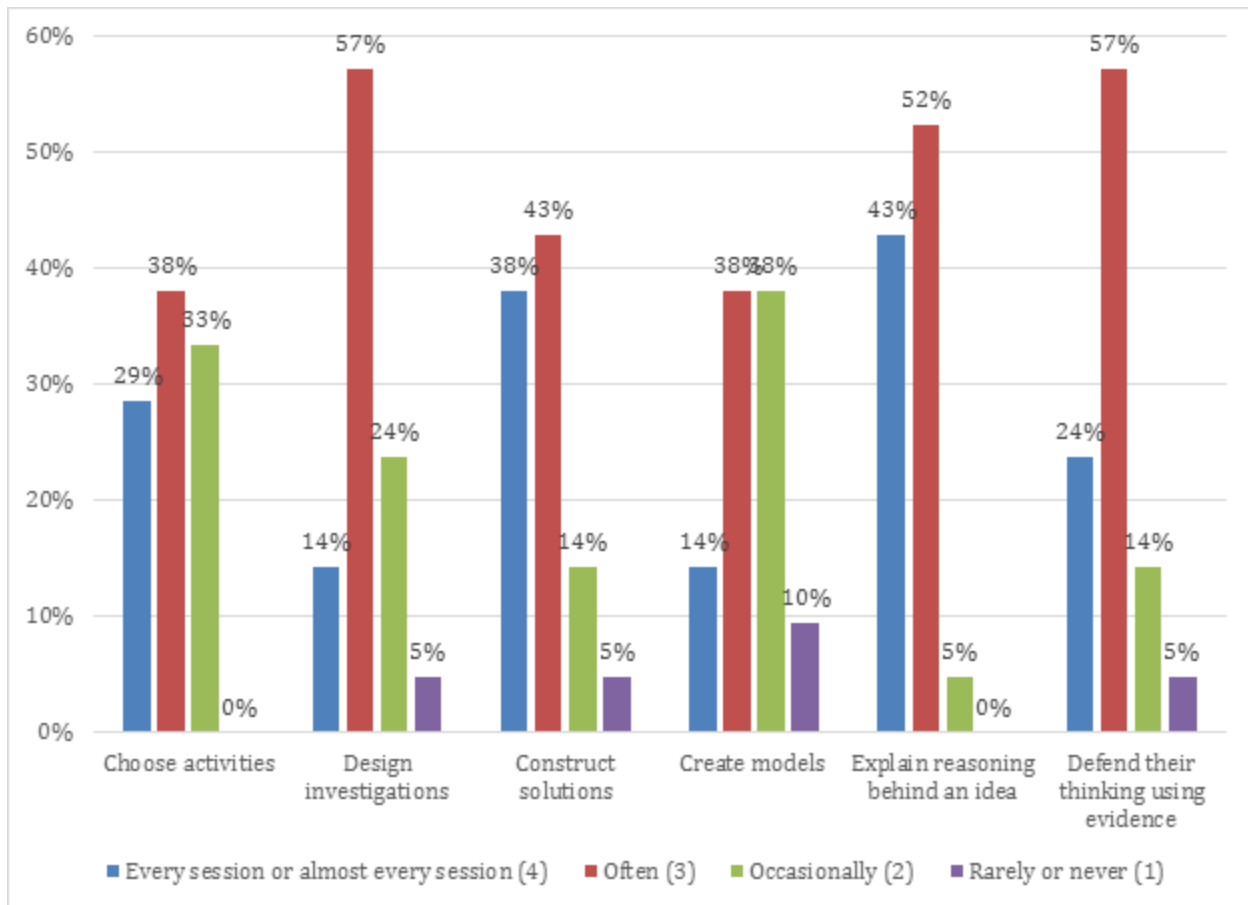
Figure 3. How often did youth do each of the following in your STEM out-of-school programs? 21 providers responded to this survey.

We also asked program providers to tell us how often youth in their programs engaged in each of several practices (similar but not exactly the same as presented in the exit interview, see Figure 2). This provided greater depth in not just showing us which practices program providers used, but just how often they did so. These data indicated that not only did youth in the programs supported by SBS do many of the interactive, student-centered applied learning aligned to NGSS practices, but they also did many of them often or every session/almost every session (Figure 3). These data demonstrate the depth of interactive STEM learning opportunities that out-of-school programs can provide to youth. Data from Figure 3 is consistent with data presented in Figure 2 as being a practice that many program providers focused on with 71% reporting youth "designed investigations" often or every session/almost every session.

Outcome 4: Increase out-of-school STEM programming to historically underserved student populations (grades 3-8) in science, engineering, and mathematics.

Table 7. Demographic information for 638 participants in the STEM Beyond School project based on Oregon Department of Education criteria for combined disadvantaged (historically underserved races/ethnicities, economically disadvantaged students, English learning students, and students with disabilities).

Category	%
Historically underserved races/ethnicities	51%
English Learners	13%
Students Experiencing Poverty	78%
Students with Disabilities	14%
Combined Disadvantaged[1]	87%

[1]Note that some youth who participated in SBS are considered underserved based on more than one category, but that they are only factored into the "combined" value once.

Demographic data obtained from the Oregon Department of Education indicated strong support for this outcome. Out of the 638 participants in the STEM Beyond School project for whom we had data, 87% of them are considered disadvantaged. In addition, over half of youth served by SBS were from historically underserved races/ethnicities and over three quarters were experiencing poverty (Table 7).

Outcome 5: Develop a statewide network of out-of-school providers to disseminate and implement effective practices, ideas and resources for STEM-related education.

A major goal of SBS was to establish a network of out-of-school STEM providers across the state of Oregon that serves as the foundation for peer-exchange and support oriented towards reflection and ongoing improvement. The providers were to take part in a variety of professional development (PD) opportunities in support of an ongoing reflection and improvement process, including webinars, learning communities, and in-person convenings. In general, we found strong and consistent evidence indicating that the SBS Program was successful in meeting this goal. In an end-of-year interview between Regional Coordinators

and program providers, 13 out of the 18 providers responding (72%) agreed or strongly agreed that participation in SBS PD and events supported sharing of programming ideas and provided a forum for learning and sharing with other educators.

Of all the PD opportunities, *the all-program event was considered most useful* to providers for networking with other programs and gaining practical resources and ideas for improving their programming. Because of the perceived value for such events in relationship development among sites and with the SBS program team, several respondents suggested including another of these events earlier in the year.

The SBS Learning Communities were opportunities for smaller groups of providers to come together for a specific period of time (~6 weeks) on a topic of shared need, to learn together usually under the guidance of a practitioner with expertise or experience associated with the selected topic. This year, four Learning Communities were offered: 1) Partnership in STEM, 2) Do'ers and Designers Workshop, 3) Trauma-Informed Practice, and 4) Making it Matter – Relevance.

These learning communities were deemed useful by 13 of 18 respondents who attended at least one workshop. In particular, the Do'ers and Designers and Trauma-Informed Practice workshops were considered most valuable. Major benefits included learning to create more interactive activities and the ability to ask questions and interact with other programs. Because learning communities focused on specialized topics of interest to participants, and offered opportunities for discussion and networking, they helped many providers become more comfortable offering STEM content and activities.

A similar number of respondents regarded the webinars as useful in guiding their programming. Several emphasized the value of breakout sessions in which they could interact with other participants in smaller groups. Others reported that the webinars helped them feel like a part of a larger community where participants could share successes and failures and hear what other sites were doing. There was a general appreciation for the variety of topics offered although scheduling was still difficult for a number of program providers.

As further evidence of the success of SBS in creating and supporting a network of connected out-of-school STEM providers, *nearly every participant was able to provide an example of a new relationship they developed as a result of SBS*, or an existing relationship that was strengthened through the program. Although the majority of these connections were with other SBS participants, some sites described creating better relationships with parents, schools, and other community organizations (e.g., Portland Community College, Intel) that were valuable in reaching and working with underserved populations. The importance of these connections and their potential ramifications for program sustainability cannot be overstated. As one participant noted, "Working with each other as two educators from two different organizations has created a relationship that will continue beyond the grant."

Outcome 6: Develop baseline data elements to inform size, scope, quality and student outcomes of out-of-school STEM-aligned activities

In the first year of the project, STEM Beyond School focused on developing or modifying analysis instruments and survey tools to address the outcomes and inform the development of a sustainable infrastructure that would support a Networked Learning Community of community-based STEM education providers. In Year 2, the focus was on refining these tools to collect data in such a way that it could be used better to evaluate the outcomes and support the project goals:

1. Statewide infrastructure with regional coordination and statewide supports in concert with the Regional STEM Hubs
2. Online reporting workbooks for sites. Modified to be more streamlined and easier for providers to use
3. Slightly modified the Student Affective Survey to include an item measuring youth motivation to participate. Retained the seven affective measures from the Year 1 post-survey.
4. Self-Assessment Process that includes a tool to inform PD plan and individual provider goals
5. Flexible Professional Development Process to provide "just in time" opportunities
6. Site provider exit interview protocols
7. Program characteristics survey, post-program only - NEW

Outcome 7: Increase opportunities for career-connected learning to ensure students see and believe they have a pathway for achieving a high school diploma and post-high school careers related to STEM.

Providing opportunities for youth to connect to STEM careers and/or STEM professionals was an overall strength of the SBS program. Almost every program provider who engaged in an exit interview (21 out of 23) reported they offered these kinds of opportunities for youth in their programming. A common theme across programs was a focus on natural resources professions. Over half of the programs reported engaging students with natural resource professionals such as fish biologists, wildlife biologists, timber scientists, marine scientists either as invited speakers or talking with them during field trips. The most commonly mentioned career connections were professionals at the Hatfield Marine Science Center or OMSI, and Oregon Department of Fish and Wildlife employees. Other STEM professionals that were mentioned include an Audubon Society volunteer, an Avalanche expert, and staff at the Oregon Zoo and Clean Water Services. Engineering was another focus of many programs' career-connected learning. Examples include a tour of the Portland State University Maseeh College of Engineering, Intel, and the STEM Conference for girls put on by the Society of Women Engineers in Portland. Other programs highlighted health sciences careers, aviation-related careers, and technology-oriented careers such as videography.

Some programs reported novel ideas to incorporate aspects of STEM careers into their programs. For example, one program started most of their sessions with short videos of

professionals in different fields of expertise. Another element used in programs was to allow youth to vote before the start of programs to choose locations they wanted to visit. In this case, the program provided the following connections based on youth votes: a mechanic, a welder, an EMT/firefighter, a ranch resort chef, a veterinarian, and an inventor. Several programs made special efforts to connect youth to professionals who represented a diverse set of role models such as women, Spanish speakers, people of color, or recent immigrants.
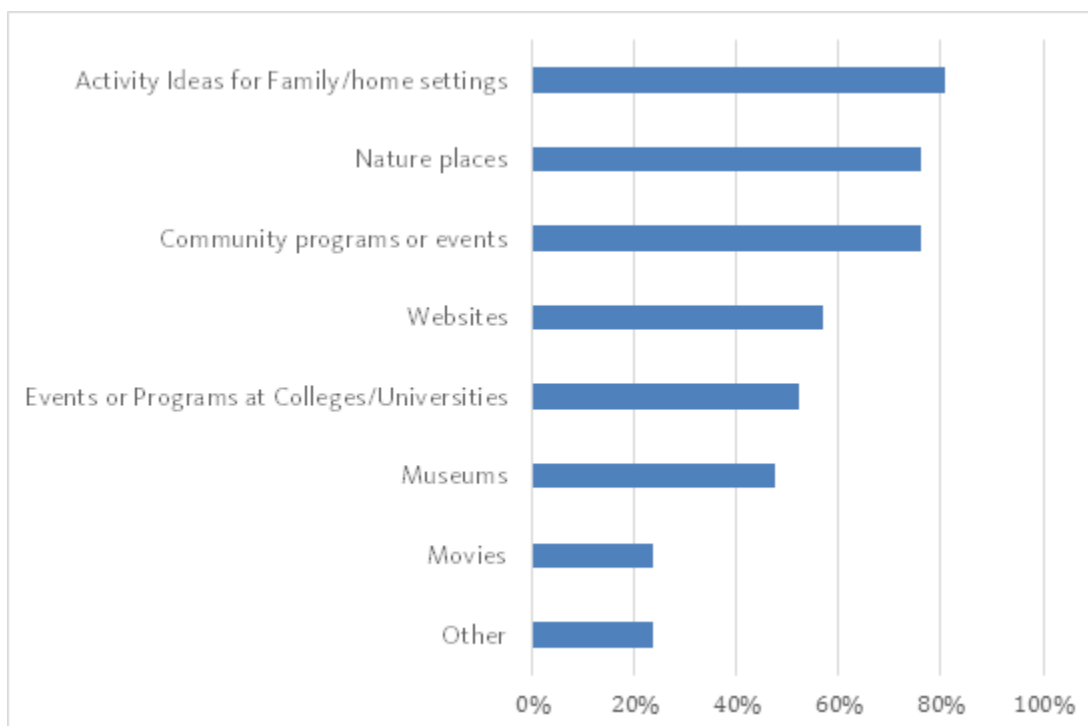
Figure 4. Percentage of programs that connected their students and/or their families to additional STEM learning opportunities outside of the program.

In addition to career-connected opportunities, we asked program providers to choose from a list of additional STEM learning opportunities to which youth or their families were connected outside of the program. A majority of programs offered activity ideas for family/home settings, followed closely by community programs or events and nature places. Connecting youth to additional opportunities and making connections between programs and family are both effective approaches to increasing STEM youth interest and motivation (NRC 2015). Examples of "other" included STEM nights at their school, Aquariums, career events, family STEM events.

Conclusions and Lessons to Inform Future Project

Concluding on the overall research questions

The preponderance of evidence indicates that in Year 2, the SBS project by and large succeeded in achieving the desired outcomes as summarized above. Our findings indicate that the SBS project led to the continued development and refinement of diverse, engaging and highly interactive STEM opportunities for underserved youth including hands-on activities, engineering design challenges, and outdoor field experiences. In addition, program providers often incorporated opportunities for students to visit college and university campuses, meet with STEM professionals and learn about STEM career opportunities, and encouraged students to think about their futures and choosing a STEM-related path. In addition to these positive experiences for youth, providers themselves reported that the SBS project provided resources and structural supports that helped them work together as a cohesive network to learn about and implement effective STEM practices to better serve youth in their communities. However, on the basis of our evaluation, there are a number of areas of the project that could be refined or strengthened in the future to ensure that the outcomes of SBS continue to be met in the coming years.

Recommendations to inform future projects

In this section, we provide specific recommendations based on findings from this study to inform future iterations of the SBS project.

Supporting Continued Youth STEM Engagement through SBS

Based on the overall evidence of program impact on youth, staff and providers, and on the program's potential for future impact, we recommend continued support to grow and improve opportunities for quality STEM engagement of youth through the STEM Beyond School project.

Supporting Program Quality

In general, program providers focused most strongly on the practices of designing, testing, and redesigning engineering solutions and observing and asking questions about the world around them. In the future, we recommend that providers be supported in engaging students in using charts/graphs/computer simulations to display/analyze data and creating and using models to explain/predict. Part of this support may include having an intentional discussion about how to make these practices less "school-like" and whether working with charts, graphs, and computers is a priority practice for the program. Relatedly, one provider did report that they would like to see SBS have a "continued focus and emphasis on math with more examples of math activities & ways to bring out the "M" in STEM."

We also highlight specific suggestions of note from SBS providers:

- Continue to advocate on behalf of younger students and supporting them in STEM to maximize the impact of programs like SBS.
- Support regional gatherings where each provider shares ideas and plans for a common kind of event like a family STEM night.

In general, providers focused most strongly on two of the 4 Core Programming Areas: Students as Do'ers and Designers, and Youth Interest Driven Programming. In the future, we recommend that providers be:
- supported in creating activities that focus on community,
- encouraged to explicitly attend to youth interest when developing programs,
- engaged in PD experiences that enable them to develop activities in which youth apply the skills or knowledge they learned to novel situations.

Encouraging network development and sustainability

Although the majority of program providers (72%) felt that SBS PD and events supported sharing ideas with other educators, it is clear that providers need continuing support in order to connect with others and feel part of a larger network of STEM providers. Based on our evaluation we recommend:
- more face-to-face events, including a second all-program event and additional local/regional level face-to-face gatherings such as "drop-in" gatherings at coffee shops,
- encourage and support providers to do site-visits in their own or other regions to learn and share ideas with others,
- continue to offer the Do'ers and Designers Workshop and Trauma-Informed Practice Learning Communities and offer an opportunity for program providers to share what additional workshops would be useful for informing their practice,
- ensure that webinars address topics of interest to providers and that there is ample time for participants to interact in smaller groups.

Measuring youth outcomes

For a variety of reasons (e.g., the ceiling effect, high absenteeism and turnover in youth participants), it may not be possible for the SBS Program to fully create or document the desired changes in youth affective outcomes as measured with the Student Affective Survey. The reality is that there are many other factors affecting youth STEM identity and interest including social interactions at home, in school and in the larger world (Aschbacher, Li, & Roth, 2010). Therefore, it is difficult for relatively short-term out-of-school programs to "move the needle" in measurable ways on something as profound as interest or identity. However, that does not mean that such programs are not important or impactful in supporting or solidifying interest and identity development in youth, or in supporting other valued outcomes. It only means that other measures of success may be necessary in order to better understand the effects of the SBS program on the youth who participate, particularly those youth who enter

the program with already well-developed STEM identity and interest. Therefore, in addition to the survey, we recommend considering the following youth assessments:

- utilize embedded assessments of key skills that providers want youth to master (this allows for linking actual success in getting better at something to a sense of accomplishment or self-efficacy in youth),
- encourage providers to use simple measures of cognitive gain such as the Youth Feedback Guidelines (attached) to allow youth to reflect on the program in real time and indicate how their understanding changed as part of the program,
- instead of the pre- and post-survey design, utilize a retrospective survey administered only at the end of the program to eliminate issues of few matched pairs, response-shift bias and survey fatigue, and to allow youth to reflect on the influence of the program itself on putative changes.

When the State of Oregon decided to support a statewide project to support and foster afterschool or out-of-school STEM experiences for youth while also investing into the institutions and staff that provide these experiences, it did so with the clear understanding that these experiences have the potential to influence youth in profound ways, but that this potential is yet not fully realized. Oregon is not alone in this way of thinking. National organizations such as the Afterschool Alliance have long advocated for the value of more quality STEM experiences in out-of-school settings, while realizing that providers of such experiences are facing formidable challenges. STEM Beyond School is not only a contribution to the betterment of STEM engagement in Oregon, but the lessons learned will ultimately contribute to the strengthening of out-of-school STEM learning nationwide.

References

Aschbacher, P. R., Li, E., & Roth, E. J. (2010). Is science me? High school students' identities, participation and aspirations in science, engineering, and medicine. *Journal of Research in Science Teaching, 47*(5), 564-582.

Blank, Rolf K. (2012). What Is the Impact of Decline in Science Instructional Time in Elementary School? Paper prepared for the Noyce Foundation. Retrieved from http://www.csss-science.org/downloads/NAEPElemScienceData.pdf

Byrnes, J. P. (1996). *Cognitive Development and Learning in Instructional Contexts*. Boston: Allyn and Bacon.

Carlone, H. B., & Johnson, A. (2007). Understanding the science experiences of successful women of color: science identity as an analytic lens. *Journal of Research in Science Teaching, 44*(8), 1187-1218.

Cole, S. (2012). The development of science identity: An evaluation of youth development programs at the Museum of Science and Industry, Chicago (Doctoral dissertation). Retrieved from Loyola eCommons.

Frenzel, A. C., Goetz, T., Pekrun, R., & Watt, H. M. G. (2010). Development of mathematics interest in adolescence: Influences of gender, family, and school context. *Journal of Research on Adolescence, 20*(2), 507-537.

Gerard, R. W. (1957). Units and concepts of biology. *Science, 125*, 429-433.

Greenfield, T. A. (1996). Gender, ethnicity, science achievement, and attitudes. *Journal of Research in Science Teaching, 33*, 901-934.

Hidi, S. & Renninger, K. A. (2006). The four phase model of interest development. *Educational Psychologist, 41*, 111-127.

Jacobs, J. E., Davis-Kean, P., Bleeker, M., Eccles, J. S., & Malanchuk, O. (2005). "I can, but I don't want to," the impact of parents, interests, and activities on gender differences in math. In A. M. Gallagher & J. C. Kaufman (Eds.), *Gender differences in mathematics*. Cambridge University Press.

Maltese, A. V., Melki, C. S., & Wiebke, H. L. (2014). The nature of experiences responsible for the generation and maintenance of interest in STEM. *Science Education, 98,* 937-962.

Maltese, A.V., & Tai, R.H. (2011). Pipeline persistence: Examining the association of educational experiences with earned degrees in STEM among U.S. students. *Science Education, 95*, 877-907.

National Research Council (2000). *How people learn: Brain, mind, experience, and school*. Washington D.C.: National Academy Press.

National Research Council (2009). *Learning Science in Informal Environments: People, Places and Pursuits*. Washington, DC: The National Academy Press.

National Research Council (2015). *Identifying and Supporting Productive STEM Programs in Out-of-School Settings*. Washington, DC: The National Academies Press.

Renninger, K. A. & Su, S. (2012). Interest and its development. In R. Ryan (Ed.), *The Oxford handbook of human motivation* (pp. 167-187). New York: Oxford University Press.

Saxton, E., Holveck, S., Burns, R., Kelley, S., Prince, D., Rigelman, N., & Skinner, E. (2014). A Common Measurement System for K-12 STEM education: Adopting an educational

evaluation methodology that elevates theoretical foundations and systems thinking. Studies in Educational Evaluation, 40, 18-35. doi:10.1016/j.stueduc.2013.11.005

Wai, J., Lubinski, D., Benbow, C.P. & Steiger, J.H. (2010). Accomplishment in science, technology, engineering, and mathematics (STEM) and its relation to STEM educational dose: A 25-year longitudinal study. *Journal of Educational Psychology, 102*(4), 860–871.

Technical Appendix (Methods)

Student Affective Survey

In Year 1, the STEM Beyond School project focused on developing an instrument in conjunction with the Portland Metro STEM Partnership's Common Measures project to measure student attitudes and other affective outcomes. The SBS pre-survey was originally based on the existing PMSP Student Affective Survey with modifications based on the following principles: 1) measurable, 2) teachable/malleable (clear teaching strategies available), 3) Research/Evidence-based, and 4) can be validated.

After an intensive piloting process, the survey was redesigned to include all desired affective concepts while addressing issues of length and clarity and administered as the post-survey in Year 1. In Year 2, we retained all those items (Table A1) and included an open-ended question to capture youth motivation to participate ("Please tell us about the main reason that you are participating in this program").

Table A1. Scales and Items for pre- and post-survey. Alpha (Cronbach's alpha) is a statistic that measures internal consistency of a set of survey items.

Scale and Items
Learner Identity   Alpha: Pre: .88; Post: .84
1.   I like learning new things.
2.   I like to solve complex problems.
3.   I like going to my out-of-school activities that involve science.
4.   I like figuring things out.
5.   I can succeed in situations that involve understanding science.
6.   I would like a job that uses science when I'm an adult.
Constructive Coping and Resilience   Alpha: Pre: .76; Post: .76
7.   When I have difficulty learning something, I remind myself that this is important for my future.
8.   If I get stuck, I try something different to solve the problem.
9.   If I don't understand something in science, I ask for help.
10.   If a problem in science is really difficult, I just work harder.

Cognitive Engagement	Alpha: Pre: .76; Post: .86
11. I find topics related to science interesting.	
12. I enjoy learning new things in science.	
13. I try hard to do well in science.	
Belonging and Relatedness	Alpha: Pre: .86; Post: .88
14. I feel like I am a part of this program.	
15. I feel respected in this program.	
16. I feel comfortable in this program.	
17. I feel like I can be myself in this program.	
Purpose and Relevance	Alpha: Pre: .78; Post: .83
18. Science is important for my future.	
19. Learning science teaches me valuable skills.	
20. Science helps people solve problems to make the world a better place.	
21. Science helps people understand the world.	
Competency and Self-Efficacy	Alpha: Pre: .86; Post: .87
22. I am good at science.	
23. I can help others understand science.	
24. I am good at solving challenges that involve science.	
Net Promoter	Alpha: Pre: .82; Post: .86
25. I am satisfied with this program.	
26. I would take part in a program like this again.	
27. I would tell my friends to take part in this program.	

Self-Assessment Process

Similar to science inquiry where evidence is gathered to understand a phenomenon, effective programs gather evidence to determine what's working and what needs to change. The self-

assessment process included an online survey (self-assessment tool) for program providers to fill out as they planned their programming, and reflection on their responses partway through programming to examine their own responses to the tool and self-identify strengths and opportunities for growth. In Year 2, we modified the self-assessment tool mostly in structure to tie it more clearly to the 4 Core Programming Areas. See Appendix for a full version of the modified self-assessment tool and the self-assessment guide that was developed for facilitation of reflection about the self-assessment responses for program improvement.

The self-assessment tool was generally not used by providers at the end of their programming; instead we developed a much shorter instrument with questions taken from or modified from the self-assessment tool to get a quantitative idea of program characteristics. This new "Program Characteristics Survey" is attached in the Appendix.

Interviews with program providers

Program providers were interviewed utilizing an interview protocol by Regional Coordinators at the end of the SBS program to better understand how SBS was perceived by the providers of STEM programs for youth and how it could be improved in the future. Providers participated in a structured interview designed to examine how SBS helped sites to:
- provide high-quality STEM learning opportunities for youth
- improve STEM affective and learning outcomes
- support sharing of ideas/information with a variety of other educators

Specific information was solicited about how the PD activities (Learning Communities, webinars, NGSS Consulting, and all-program events) helped providers as well as how they could be improved in the future. Sites were also asked to briefly describe the STEM activities they provided to youth, and how SBS supported (or not) their ability to engage youth in a variety of high-quality STEM activities.

The findings from these interviews are critical in planning for future iterations of the SBS program and improving how the program works for both program providers and the youth who participate.

Youth feedback guidelines

Although this assessment was not required of providers, it was made available for those wishing for a "real-time" youth assessment tool. The tool describes an in-person reflection exercise to elicit feedback from youth to help evaluate the impact of a program in terms of STEM learning, what youth liked and disliked about the activities offered, and what aspect, element or experience associated with the program was effective in achieving potential outcomes. Results can be used to better understand youth learning in informal STEM programs and can inform changes/improvements to the program in the future.

Final instruments and tools attached

Pre_Student Affective Survey
Post_Student Affective Survey
Self-Assessment Tool
Self-Assessment Guide
STEM Beyond School Exit Interview Questions
Program Characteristics Survey
Youth Feedback Guidelines

STEM BEYOND SCHOOL: Pre Student Affective Survey

We really want to know what you think of science. Thank you for sharing your thoughts with us!
Please select only one choice for each statement.

To mark your answer, please fill in the bubble like this:	○	●	○	○	○
If you want to change your answer, do this:	○	⊗	○	●	○

	1 strongly disagree	2	3	4	5 strongly agree
I like learning new things.	○	○	○	○	○
I like to solve complex problems.	○	○	○	○	○
I like going to my out-of-school activities that involve science.	○	○	○	○	○
I like figuring things out.	○	○	○	○	○
I can succeed in situations that involve understanding science.	○	○	○	○	○
I would like a job that uses science when I'm an adult.	○	○	○	○	○
When I have difficulty learning something, I remind myself that this is important for my future.	○	○	○	○	○
If I get stuck, I try something different to solve the problem.	○	○	○	○	○
If I don't understand something in science, I ask for help.	○	○	○	○	○
If a problem in science is really difficult, I just work harder.	○	○	○	○	○
If I put in enough effort, I can succeed in science.	○	○	○	○	○
I find topics related to science interesting.	○	○	○	○	○
I enjoy learning new things in science.	○	○	○	○	○
I try hard to do well in science.	○	○	○	○	○
I feel like I am a part of this program.	○	○	○	○	○

STEM BEYOND SCHOOL: Pre Student Affective Survey

	1 strongly disagree	2	3	4	5 strongly agree
I feel respected in this program.	○	○	○	○	○
I feel comfortable in this program.	○	○	○	○	○
I feel like I can be myself in this program.	○	○	○	○	○
I do my work in science because it matters in my life.	○	○	○	○	○
Science is important for my future.	○	○	○	○	○
Learning science teaches me valuable skills.	○	○	○	○	○
Science helps people solve problems to make the world a better place.	○	○	○	○	○
Science helps people understand the world.	○	○	○	○	○
I am good at science.	○	○	○	○	○
I can help others understand science.	○	○	○	○	○
I am good at solving challenges that involve science.	○	○	○	○	○

	1 Strongly Disagree	2	3	4	5	6	7	8	9	10 Strongly Agree
I am satisfied with the program.	○	○	○	○	○	○	○	○	○	○
I would take part in a program like this again.	○	○	○	○	○	○	○	○	○	○
I would tell my friends to take part in the program.	○	○	○	○	○	○	○	○	○	○

Please continue to the next page! →

STEM BEYOND SCHOOL: Pre Student Affective Survey

Since the end of last school year in 2016, which of the following have you done or visited outside of this program?

	Yes	No
Science museum or science center	○	○
Air and Space museum	○	○
Aquarium or zoo	○	○
Maker Fair	○	○
Nature center	○	○
State, City, or National Park	○	○
Spent time in nature	○	○

Please tell us about the main reason that you are participating in this program.

Your First Name _____   Your Last Name _____

What is the name of your school? _____

What grade are you in?	4 ○	5 ○	6 ○	7 ○	8 ○

What Month were you born? (If you were born in December, you would answer "12")

What is the day of your birth? (If you were born on March 3rd, you would answer "03")

What year were you born? (If you were born in 2006, you would answer "2006")

STEM MÁS ALLÁ DE LA ESCUELA:
Encuesta afectiva para estudiantes antes del programa

Estamos muy interesados en saber qué piensas sobre las ciencias. ¡Gracias por compartir tu opinión con nosotros! Solo elige una opción por cada frase.

Para marcar tu respuesta, rellena el círculo así:	○	●	○	○	○
Si quieres cambiar tu respuesta, haz esto:	○	✗	○	●	○

	1 totalmente en desacuerdo	2	3	4	5 totalmente de acuerdo
Me gusta aprender cosas nuevas.	○	○	○	○	○
Me gusta resolver problemas complejos.	○	○	○	○	○
Me gusta ir a mis actividades extraescolares que tienen que ver con las ciencias.	○	○	○	○	○
Me gusta resolver cosas.	○	○	○	○	○
Puedo tener éxito en situaciones que tienen que ver con entender las ciencias.	○	○	○	○	○
Cuando sea grande, me gustaría tener un trabajo que use las ciencias.	○	○	○	○	○
Cuando me cuesta trabajo aprender algo, me recuerdo a mí mismo/a que esto es importante para mi futuro.	○	○	○	○	○
Cuando me atoro en un problema, intento algo diferente para resolverlo.	○	○	○	○	○
Si no entiendo algo sobre las ciencias, pido ayuda.	○	○	○	○	○
Si un problema de ciencias es realmente difícil, lo que hago es trabajar más duro.	○	○	○	○	○
Si me esfuerzo lo suficiente, puedo tener éxito en las ciencias.	○	○	○	○	○
Me interesan los temas relacionados con las ciencias.	○	○	○	○	○
Disfruto aprender cosas nuevas en las ciencias.	○	○	○	○	○

STEM MÁS ALLÁ DE LA ESCUELA:
Encuesta afectiva para estudiantes antes del programa

	1 totalmente en desacuerdo	2	3	4	5 totalmente de acuerdo
Me esfuerzo por hacer un buen trabajo en las ciencias.	○	○	○	○	○
Siento que soy parte de este programa.	○	○	○	○	○
Siento que me respetan en este programa.	○	○	○	○	○
Me siento cómodo/a en este programa.	○	○	○	○	○
Siento que puedo ser yo mismo/a en este programa.	○	○	○	○	○
Hago mi trabajo de ciencias porque es importante para mi vida.	○	○	○	○	○
Las ciencias son importantes para mi futuro.	○	○	○	○	○
Aprender ciencias me enseña habilidades valiosas.	○	○	○	○	○
Las ciencias ayudan a las personas a resolver problemas para hacer del mundo un lugar mejor.	○	○	○	○	○
Las ciencias ayudan a las personas a entender el mundo.	○	○	○	○	○
Soy bueno/a para las ciencias.	○	○	○	○	○
Puedo ayudar a otros a entender las ciencias.	○	○	○	○	○
Soy bueno/a para resolver desafíos que tienen que ver con las ciencias.	○	○	○	○	○

	1 Totalmente en desacuerdo	2	3	4	5	6	7	8	9	10 Totalmente de acuerdo
Me siento satisfecho/a con el programa.	○	○	○	○	○	○	○	○	○	○
Volvería a participar en un programa como este.	○	○	○	○	○	○	○	○	○	○

STEM MÁS ALLÁ DE LA ESCUELA:
Encuesta afectiva para estudiantes antes del programa

Invitaría a mis amigos a que participen en el programa.

○　　○　○　○　○　○　○　○　○　○

Desde el término del último año escolar en el 2016, ¿cuál de las siguientes cosas has realizado o visitado, fuera de este programa?

	Sí	No
Museo de ciencias o centro de ciencias	○	○
Museo del aire y del espacio	○	○
Zoológico ó Aquario	○	○
Feria de creadores	○	○
Centro de la naturaleza	○	○
Parque estatal, ciudad, o nacional	○	○
Pasar tiempo en la naturaleza	○	○

Cuéntanos cuál es la razón principal por la que estás participando en este programa.

Tu nombre _____ Tu apellido _____

¿Cómo se llama tu escuela? _____

¿En qué grado estás?	4	5	6	7	8
	○	○	○	○	○

¿En qué mes naciste? (Si naciste en diciembre, tu respuesta sería "12")

¿En qué día naciste? (Si naciste el 3 de marzo, tu respuesta sería "03")

¿En qué año naciste? (Si naciste en el 2006, tu respuesta sería "2006")

STEM BEYOND SCHOOL: Post Student Affective Survey

We really want to know what you think of science. Thank you for sharing your thoughts with us!
Please select only one choice for each statement.

To mark your answer, please fill in the bubble like this:	○	●	○	○	○
If you want to change your answer, do this:	○	⊗	○	●	○

	1 strongly disagree	2	3	4	5 strongly agree
I like learning new things.	○	○	○	○	○
I like to solve complex problems.	○	○	○	○	○
I like going to my out-of-school activities that involve science.	○	○	○	○	○
I like figuring things out.	○	○	○	○	○
I can succeed in situations that involve understanding science.	○	○	○	○	○
I would like a job that uses science when I'm an adult.	○	○	○	○	○
When I have difficulty learning something, I remind myself that this is important for my future.	○	○	○	○	○
If I get stuck, I try something different to solve the problem.	○	○	○	○	○
If I don't understand something in science, I ask for help.	○	○	○	○	○
If a problem in science is really difficult, I just work harder.	○	○	○	○	○
If I put in enough effort, I can succeed in science.	○	○	○	○	○
I find topics related to science interesting.	○	○	○	○	○
I enjoy learning new things in science.	○	○	○	○	○
I try hard to do well in science.	○	○	○	○	○
I feel like I am a part of this program.	○	○	○	○	○

	1 strongly disagree	2	3	4	5 strongly agree
I feel respected in this program.	○	○	○	○	○
I feel comfortable in this program.	○	○	○	○	○
I feel like I can be myself in this program.	○	○	○	○	○
I do my work in science because it matters in my life.	○	○	○	○	○
Science is important for my future.	○	○	○	○	○
Learning science teaches me valuable skills.	○	○	○	○	○
Science helps people solve problems to make the world a better place.	○	○	○	○	○
Science helps people understand the world.	○	○	○	○	○
I am good at science.	○	○	○	○	○
I can help others understand science.	○	○	○	○	○
I am good at solving challenges that involve science.	○	○	○	○	○

	1 Strongly Disagree	2	3	4	5	6	7	8	9	10 Strongly Agree
I am satisfied with the program.	○	○	○	○	○	○	○	○	○	○
I would take part in a program like this again.	○	○	○	○	○	○	○	○	○	○
I would tell my friends to take part in the program.	○	○	○	○	○	○	○	○	○	○

Please continue to the next page! →

STEM BEYOND SCHOOL: Post Student Affective Survey

Since the end of last school year in 2016, which of the following have you done or visited outside of this program?

	Yes	No
Science museum or science center	○	○
Air and Space museum	○	○
Aquarium or zoo	○	○
Maker Fair	○	○
Nature center	○	○
State, City, or National Park	○	○
Spent time in nature	○	○

Please tell us what you liked most about the program.

Did you participate in this program last year?   Yes ○   No ○

Your First Name _____   Your Last Name _____

What is the name of your school? _____

What grade are you in?	4 ○	5 ○	6 ○	7 ○	8 ○

What Month were you born? (If you were born in December, you would answer "12")

What is the day of your birth? (If you were born on March 3rd, you would answer "03")

What year were you born? (If you were born in 2006, you would answer "2006")

STEM MÁS ALLÁ DE LA ESCUELA:
Encuesta afectiva para estudiantes después del programa

Estamos muy interesados en saber qué piensas sobre las ciencias. ¡Gracias por compartir tu opinión con nosotros! Solo elige una opción por cada frase.

Para marcar tu respuesta, rellena el círculo así:	◯	●	◯	◯	◯
Si quieres cambiar tu respuesta, haz esto:	◯	⊗	◯	●	◯

	1 totalmente en desacuerdo	2	3	4	5 totalmente de acuerdo
Me gusta aprender cosas nuevas.	◯	◯	◯	◯	◯
Me gusta resolver problemas complejos.	◯	◯	◯	◯	◯
Me gusta ir a mis actividades extraescolares que tienen que ver con las ciencias.	◯	◯	◯	◯	◯
Me gusta resolver cosas.	◯	◯	◯	◯	◯
Puedo tener éxito en situaciones que tienen que ver con entender las ciencias.	◯	◯	◯	◯	◯
Cuando sea grande, me gustaría tener un trabajo que use las ciencias.	◯	◯	◯	◯	◯
Cuando me cuesta trabajo aprender algo, me recuerdo a mí mismo/a que esto es importante para mi futuro.	◯	◯	◯	◯	◯
Cuando me atoro en un problema, intento algo diferente para resolverlo.	◯	◯	◯	◯	◯
Si no entiendo algo sobre las ciencias, pido ayuda.	◯	◯	◯	◯	◯
Si un problema de ciencias es realmente difícil, lo que hago es trabajar más duro.	◯	◯	◯	◯	◯
Si me esfuerzo lo suficiente, puedo tener éxito en las ciencias.	◯	◯	◯	◯	◯
Me interesan los temas relacionados con las ciencias.	◯	◯	◯	◯	◯
Disfruto aprender cosas nuevas en las ciencias.	◯	◯	◯	◯	◯

STEM MÁS ALLÁ DE LA ESCUELA:
Encuesta afectiva para estudiantes después del programa

	1 totalmente en desacuerdo	2	3	4	5 totalmente de acuerdo
Me esfuerzo por hacer un buen trabajo en las ciencias.	◯	◯	◯	◯	◯
Siento que soy parte de este programa.	◯	◯	◯	◯	◯
Siento que me respetan en este programa.	◯	◯	◯	◯	◯
Me siento cómodo/a en este programa.	◯	◯	◯	◯	◯
Siento que puedo ser yo mismo/a en este programa.	◯	◯	◯	◯	◯
Hago mi trabajo de ciencias porque es importante para mi vida.	◯	◯	◯	◯	◯
Las ciencias son importantes para mi futuro.	◯	◯	◯	◯	◯
Aprender ciencias me enseña habilidades valiosas.	◯	◯	◯	◯	◯
Las ciencias ayudan a las personas a resolver problemas para hacer del mundo un lugar mejor.	◯	◯	◯	◯	◯
Las ciencias ayudan a las personas a entender el mundo.	◯	◯	◯	◯	◯
Soy bueno/a para las ciencias.	◯	◯	◯	◯	◯
Puedo ayudar a otros a entender las ciencias.	◯	◯	◯	◯	◯
Soy bueno/a para resolver desafíos que tienen que ver con las ciencias.	◯	◯	◯	◯	◯

	1 Totalmente en desacuerdo	2	3	4	5	6	7	8	9	10 Totalmente de acuerdo
Me siento satisfecho/a con el programa.	◯	◯	◯	◯	◯	◯	◯	◯	◯	◯
Volvería a participar en un programa como este.	◯	◯	◯	◯	◯	◯	◯	◯	◯	◯

STEM MÁS ALLÁ DE LA ESCUELA:
Encuesta afectiva para estudiantes después del programa

Invitaría a mis amigos a que participen en el programa.   ◯ ◯ ◯ ◯ ◯ ◯ ◯ ◯ ◯ ◯

Desde el término del último año escolar en el 2016, ¿cuál de las siguientes cosas has realizado o visitado, fuera de este programa?	Sí	No
Museo de ciencias o centro de ciencias	◯	◯
Museo del aire y del espacio	◯	◯
Zoológico ó Aquario	◯	◯
Feria de creadores	◯	◯
Centro de la naturaleza	◯	◯
Parque estatal, ciudad, o nacional	◯	◯
Pasar tiempo en la naturaleza	◯	◯

Cuéntanos qué es lo que más te gustó del programa.

¿Participaste en este programa el año pasado?   Sí ◯   No ◯

Tu nombre _____   Tu apellido _____

¿Cómo se llama tu escuela? _____

¿En qué grado estás?	4	5	6	7	8
	◯	◯	◯	◯	◯

¿En qué mes naciste? (Si naciste en diciembre, tu respuesta sería "12")

¿En qué día naciste? (Si naciste el 3 de marzo, tu respuesta sería "03")

¿En qué año naciste? (Si naciste en el 2006, tu respuesta sería "2006")

☐☐   ☐☐   ☐☐☐☐

Default Question Block

Welcome to the STEM Beyond School Self-Assessment Tool!

Self-assessment is an important element of the STEM Beyond School (SBS) Project's approach to fostering impactful STEM programs in out-of-school settings across Oregon. We have developed this Self-Assessment Tool in order to help you in continuously improving your STEM program. The SBS Self-Assessment Tool is based on research-based practices that are known to contribute to productive STEM learning in out-of-school settings, and it is targeted specifically towards longer (e.g. 50 hours) out-of-school experiences, and the core programming requirements for SBS.

How to Use This Tool

The primary intent of the SBS Self-Assessment Tool is to support you in developing dynamic, high-quality STEM programming. We envision that completing this survey will serve as a reflective activity that supports thoughtful consideration of program change from your program's unique starting point. Consequently, keep in mind that there are no right or wrong answers here.

You can use the Self-Assessment Tool to help make informed decisions about your program planning to reflect on your initial programming (now) and near the end of the project for program reflection (March-April).

The SBS program leadership team will use all the responses on the SBS Self-Assessment Tool to identify professional development needs for the SBS project. Regional Coordinators will use the responses to help SBS program sites connect with, and learn from each other and to help SBS programs plan throughout the year.

We will share your reflections and answers with you by sending a summary to the email you'll provide us. Your coordinator will meet with you and/or your team in the weeks afterward to review any questions you might have, the specific SBS core element that your site will choose to attend to more closely this year, and the PD support needed to achieve that goal. Please feel free to share any feedback or concern about this tool in general or your use of the tool with your regional coordinator.

Thank you for your participation, and for being a champion of STEM learning in Oregon!

First, please provide the following contact information. You will receive an automated copy of your responses to this email address once you complete the self-assessment tool.

First Name

Last Name

Email Address (required)

Organization

STEM Beyond School Self-Assessment Questions

Culturally Relevant Practices

To what degree will you consider <u>cultural perspectives and practices</u> of youth in your STEM out-of-school programs?

○ High degree

○ To some degree

○ Mostly not

○ Not at all

How will you assess and identify <u>cultural perspectives and practices</u> of youth in your STEM out-of-school programs in order to include the cultural perspectives and practices in your programming? Check all that apply.

☐ Based on reasonable assumptions

☐ Based on personal or other staff person's experience

☐ Based on informal conversations with youth

☐ Based on empirical evidence from own evaluation data

☐ Based on research about audience's cultural perspectives and practices

☐ Other

Please describe a programmatic practice of cultural inclusion or cultural celebration.

Please share any challenges to understanding, supporting and/or representing the cultural perspective and practices of youth in your STEM out-of-school programs.

Responding to Youth Interests

In your initial program plan, to what degree will you consider the <u>interests</u> of youth in your STEM out-of-school programs?

○ High degree

○ To some degree

○ Mostly not

○ Not at all

How will you assess and identify the <u>interests</u> of youth in your STEM out-of-school programs in order to include their interests in your programming? Check all that apply.

☐ Based on reasonable assumptions

☐ Based on personal or other staff person's experience

☐ Based on informal conversations with youth

☐ Based on own empirical evidence from evaluation data

☐ Based on general research on youth interest

☐ Other [   ]

Please describe an example source of information:

[   ]

How often will youth have an opportunity to choose projects or activities?

○ Rarely or never

○ Occasionally

○ Often

○ Every session or almost every session

Engaging Students as Do'ers & Designers

How often will YOUTH do each of the following in your STEM out-of-school programs?

	Please choose the category that represents your best estimate.				If this is this an area you would like help with, please click yes below.
	Rarely or Never	Occasionally	Often	Every session or almost every session	yes
Develop their OWN question or choose their own challenge to explore	○	○	○	○	☐
Choose things to investigate (such as stream temperature, velocity, or slope)	○	○	○	○	☐
Design their OWN investigations	○	○	○	○	☐
Implement their OWN investigations	○	○	○	○	☐

	Please choose the category that represents your best estimate.				If this is this an area you would like help with, please click yes below.
	Rarely or Never	Occasionally	Often	Every session or almost every session	yes
Construct or build their OWN solution to a problem or challenge	○	○	○	○	☐
Try a new or different solution for the same problem or challenge	○	○	○	○	☐
Make and record observations	○	○	○	○	☐
Gather quantitative (numbers) or qualitative (descriptive) data	○	○	○	○	☐
	Rarely or Never	Occasionally	Often	Every session or almost every session	yes
Analyze relationships using charts or graphs	○	○	○	○	☐
Analyze results using basic statistics (e.g., mean, median, distribution)	○	○	○	○	☐
Explain the reasoning behind an idea	○	○	○	○	☐
Write about what was observed and why it happened	○	○	○	○	☐
Give some form of presentation to the group (either informally or in a formal way)	○	○	○	○	☐
Use evidence to support or refute a claim	○	○	○	○	☐
Create a physical model of a scientific idea, such as a model of the solar system	○	○	○	○	☐
Use models or model thinking to explain observations or data	○	○	○	○	☐

How often will you (as the instructor) do each of the following in your STEM out-of-school programs:

	Please choose the category that represents your best estimate				If this is this an area you would like help with, please click yes below.
	Rarely or never	Occasionally	Often	Every session or almost every session	yes
Explain STEM concepts to youth primarily through verbal means	○	○	○	○	☐
Have youth watch you demonstrate an experiment, process, equipment, or tool	○	○	○	○	☐
Use activity sheets to practice skills or content	○	○	○	○	☐
Review and/or define STEM vocabulary	○	○	○	○	☐
Use open-ended questions to stimulate whole group discussion	○	○	○	○	☐
Have youth work with each other in small groups	○	○	○	○	☐
Support youth to question each other in respectful ways	○	○	○	○	☐
Encourage youth to explain concepts to one another	○	○	○	○	☐

How often will you (as the instructor) do each of the following in your STEM out-of-school programs?

	Please choose the category that represents your best estimate				If this is this an area you would like help with, please click yes below.
	Rarely or never	Occasionally	Often	Every session or almost every session	yes
Encourage youth to try again if they don't succeed the first time	○	○	○	○	☐

	Please choose the category that represents your best estimate				If this is this an area you would like help with, please click yes below.
	Rarely or never	Occasionally	Often	Every session or almost every session	yes
Create a culture of trying new things and learning from mistakes	○	○	○	○	☐

Supporting a Social Experience

In your initial program plan, please roughly estimate the approximate % of time youth spent in:

Large group work (whole group involved in activity or discussion)	0	%
Small group work (split into multiple small groups)	0	%
Dyads (work done in pairs)	0	%
Alone/individual work	0	%
Other [ ]	0	%
Total	0	%

When youth are working in small groups, how will the small groups be structured (check all that apply)?

☐ Youth work in unstructured teams and/or small groups

☐ Youth choose their tasks or roles within teams

☐ Tasks or roles are assigned within teams according to youth's perceived strengths

☐ Tasks or roles are assigned within teams so that youth can develop new skills

☐ Tasks and roles are intentionally rotated over time (youth cannot just select what they think are their strengths)

In your initial program plan, please roughly estimate the % of time that instructors will utilize the following roles:

Expert/conveyor of information	0	%
Facilitator of experiences	0	%
Co-learner, together with youth	0	%
Other	0	%
Total	0	%

Connecting with and supporting youth learning across settings, including school, home, and community

How often will you (as the instructor) do each of the following in your STEM out-of-school programs:

	Please choose the category that represents your best estimate				If this is this an area you would like help with, please click yes below.
	Rarely or never	Occasionally	Often	Every session or almost every session	yes
Use STEM concepts to explain natural events or real-world situations (connecting what youth are learning to real-world situations)	○	○	○	○	☐
Talk with youth about things they can do at home that are similar to those done in your program	○	○	○	○	☐
Facilitate sharing of youth's relevant STEM prior knowledge or experience	○	○	○	○	☐

How often will youth be expected to <u>take</u> ideas, activities, objects they created, etc. home?

○ Never

○ Rarely

○ Sometimes

○ Often

○ Always

How often will youth be invited to <u>bring</u> ideas, activities, objects they created from home?

○ Never

○ Rarely

○ Sometimes

○ Often

○ Always

Do you plan to connect your students and/or their families to additional STEM learning opportunities (e.g. providing flyers about an event in the community that is related to program content) outside of your program? If so, check all that apply.

Connecting students to additional opportunities that they can participate in their spare time builds STEM interest and identity.

	Yes	No	Maybe
Museums	○	○	○
Websites	○	○	○
Activity Ideas for Family/home settings	○	○	○
Nature places (parks, etc.)	○	○	○
Movies	○	○	○

	Yes	No	Maybe
Events or Programs at Colleges/universities	○	○	○
Community programs or events (e.g., library)	○	○	○
Other [ ]	○	○	○

Will community members be involved in the program?

○ Yes

○ No

Which community members will be involved in the program (Check all that apply)?

☐ Families of participating youth

☐ Business/industry representatives

☐ People from community-based organizations (non-profits)

☐ People from government agencies

☐ Other [_____]

What will their roles be in the program?

[text box]

What challenges (if any) do you face when involving community members in your STEM out-of-school program?

[text box]

What strategies or ideas do you anticipate using to engage families as partners in out-of-school STEM learning?

Developing a coherent 50-hour youth experience

Will youth have opportunities to practice skills during your program:

	Rarely or never	Occasionally	Often	Every session or almost every session
Within a similar situation or context in which they learned them (e.g., same skill, SIMILAR situation)?	○	○	○	○
Within a new situation or context (e.g., same skill, NEW situation)?	○	○	○	○

Coherence (a sequence of learning experiences that are connected and build upon each other during the course of the program) allows students to develop their knowledge and understanding of concepts and practice/use of skills over time and in a variety of settings. Coherence may be harder to achieve when programming is driven by student interests and needs.

How would you rate the level of coherence of your program? Please rate the following between 1 (low coherence - multiple individual learning experiences with little to no connections between them) and 10 (high coherence - a sequence of learning experiences that are connected and build upon each other during the course of the program).

| 0 | 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9 | 10 |

	0	1	2	3	4	5	6	7	8	9	10

Move the bar slider

What level of coherence are you seeking in your program? Please rate the following between 1 (Multiple individual learning experiences with little to no connections between them) and 10 (a sequence of learning experiences that are connected and build upon each other during the course of the program).

	0	1	3	4	5	6	8	9	10

Move the bar slider

Do you need assistance to meet the SBS requirement of 51% of programming to be off-site?

○ Yes

○ No

Strategies and tools for assessing student progress

Please describe how you plan to assess youth learning.

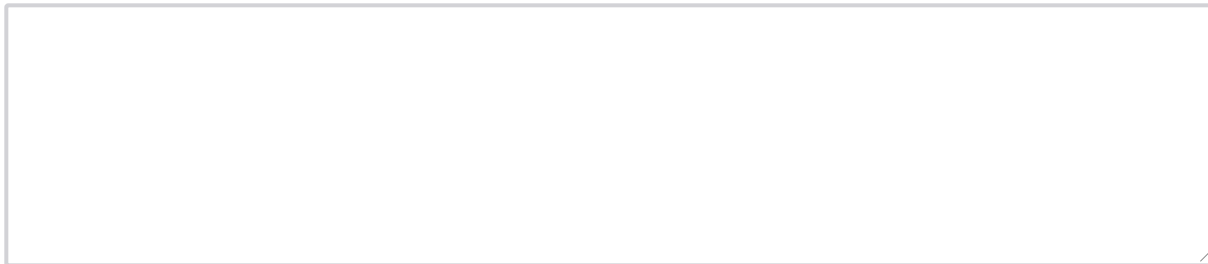Would you like to learn more about ways to assess student learning?

○ Yes

○ No

Final thoughts

What additional support may benefit you in planning high-quality STEM out-of-school programs?

Please write any additional notes and thoughts here.

Self-Assessment Results Guide

Introduction

Thank you for taking the time and effort to fill out the STEM Beyond School Self-Assessment Tool when you were planning your program. Your thoughtful responses and now your thoughtful reflection on your responses will help you improve experiences of youth in your out-of-school programs.

This guide helps you ask questions to your own responses. As you are looking at your own responses, keep in mind that the self-assessment tool questions are meant to help you reflect on your program. They do not necessarily indicate any right or wrong direction since programs differ so dramatically in focus, goals, lived experience etc. We recommend that you discuss reflections with others in your regional group to find answers to your questions, or to even generate questions that can be discussed. Ultimately, the ideal is for you to find a way to make changes to your program (or keep doing things), based on thoughtful analysis and reflection. The SBS team will be available to provide support where needed in addressing potentially difficult issues.

How to Use this Guide

This guide is framed around the four SBS programming requirements. We recommend that you start by choosing one of the requirements on which to focus. Then move on to others. We suggest that you use the following flow when using this guide to reflect on your own responses.

1. Read brief "why it's important" section.
2. Review your own responses to the self-assessment tool (or the responses given by the person who filled out the tool for your site). This review can serve as a reminder to revisit where you were at the time. We have given you pointers of the questions that most relate to each SBS programming requirement.
3. Discuss the important considerations with your team or other program providers.
4. Discuss the reflection questions with your team or other program providers.
5. Consider the cross-cutting themes of "Supportive Learning Community" and "Cultural Perspectives" in *all* the discussions.
6. Use pages 7 & 8 to take notes on your decisions and next steps for each of the four SBS Programming Areas.

[Type here]

Cross-cutting Themes

Supportive Learning Community

Establishing a supportive learning community that encourages discovery and exploration of the unknown is an important part of all SBS programming requirements. The 2015 National Academies of Science report on *Identifying and Supporting Productive STEM Programs in Out-of-School Settings* (NRC 2015) describes the importance of providing an environment where "young people are encouraged to develop their own questions, to devise ways of investigating and addressing those questions, and to share the results of their inquiries, which will often be tentative" (p. 19). To specifically consider how your programming is encouraging a supportive learning community, look at your responses to questions 8, 19-20, and 22 and also consider this concept when reflecting upon the four SBS programming requirements (see below).

Cultural Perspectives

Consideration of youth's personal experiences, cultural perspectives, and interests is critical for engaging youth in STEM learning (and learning in general). When youth engage in learning and doing science and engineering, they bring their cultural worldviews with them. Programs can acknowledge this reality by building upon lived experiences of their participants and providing space for multiple voices to be heard. These strategies are effective ways to engage all youth in the learning of STEM. To specifically consider how your programming is responsive to cultural perspectives, look at your responses to questions 2,3,4,5 and also consider this concept when reflecting upon all four SBS programming requirements (see below). To read more about this topic, refer to Ciechanowski et al. 2015.

STEM Beyond School Programming Requirements (the 4 Core)

1. Core Programming Element: Youth Driven - Responsive to Youth Needs and Interests

Why Youth Driven is Important:

Structuring learning opportunities that give youth choice is a powerful tool to motivate their learning. Youth become purposeful learners who engage in an activity because they want to, not because someone else told them to. Research shows that when youth recognize a question,

[Type here]

problem, or strategy as meaningful, they are more likely to become interested in it, and to persist in learning it. Structuring out-of-school STEM programs that are responsive to youths' prior interests and experiences so that they can see STEM as personally meaningful and relevant may be especially important for youth from communities historically underrepresented in STEM fields. To read more about this topic refer to National Research Council (2015, pp. 20-21).

Please review your responses to the following Self-Assessment questions

- 10 (1-7) How often will youth do each of the following…
    - Develop their own question or choose their own challenge to explore
    - Choose things to investigate (such as stream temperature, …)
    - Design their own investigations
    - Implement their own investigations
    - Construct or build their own solution...
- 6-8, 9, 13

Important Considerations

- Youth needs may include such factors as feeling safe and part of a community, developing positive relationships with adults other than their parents, being involved in creative activities, having opportunities to plan and be in decision-making roles, and providing opportunity for control and ownership of their situation.
- Youth interests can be tapped by providing greater autonomy or choice in both the types of activities they engage in and how they are allowed to reach the goals of the activity. For instance, you can provide students the choice to build a windmill or catapult but you can also give them the flexibility to build their device in whatever way they want (allowing mistakes, do-overs, experimentation, etc.).
- Youth choice can include both their ability to choose what they do (within reason), and who they are doing this with (group composition and degree of group-based work).

Reflection Questions

Given your discussion on programming driven by student needs and interests, ask your team the following questions:

- Are we doing enough of this for our youth? Do we want to do more of this for our youth?
- What does the Student Affective Survey data tell us about our youth in this area?
- How do the cross-cutting themes of supportive learning community and cultural perspectives contribute to this focus?
- What opportunities exist for increasing this focus?
- What supports, resources, or professional development would help us address this better?

[Type here]

2. Core Programming Element: Students as Do'ers & Designers

Why Engaging Students as Do'ers & Designers is Important

Multiple National Academy of Sciences reports on STEM learning in out-of-school settings stress the importance of engaging youth in active discovery, exploration, or making. Science, or now STEM, is not to be read about and shown, but to be experienced actively as it is being done. The Next Generation Science Standards are based on a seminal report by the Academies entitled *A Framework for K-12 Science Education*, which embraces these ideas by putting eight science and engineering practices front and center, and makes them the entry point for science education and the focus of what students will be doing when learning science. Engaging youth as active explorers, investigators, experimenters, makers, designers or builders is the bedrock on which interest development, science understanding, and motivation form. Active engagement is also where students experience and practice the ups and downs of figuring things out, and build their resilience, focus, and ultimately satisfaction in their own accomplishments. This process supports development of a growth mindset where everyone can achieve when youth struggle and succeed. Success is sweetest when earned fairly and squarely. To read more about this topic refer to National Research Council (2015, pp. 16-19).

Please review your responses to the following Self-Assessment questions

- 10 (8-16) How often will youth do each of the following…
    - Try a new or different solution for the same problem or challenge
    - Make and record observations
    - Gather quantitative (numbers) or qualitative (descriptive) data
    - Analyze relationships using charts or graphs
    - Analyze results using basic statistics
    - Explain the reasoning behind an idea
    - Write about what was observed behind an idea
    - Give some form of presentation to the group
    - Use evidence to support or refute a claim
- 11, 12

Discuss Important Considerations

- Students as do'ers & designers goes beyond hands-on learning and encompasses students' active "minds-on" engagement. For instance, students following directions or following an adult modeling the activity to complete a field investigation may be hands-on, but students asked to figure out and design the investigation are do'ers & designers.
- Learning opportunities need to be challenging enough that when students succeed, the success feels earned and legitimate. If it is too challenging, students may give up too soon and feel discouraged.
- Giving students the opportunity to choose their own question or develop their own solution to a problem also provides student interest and choice.

[Type here]

Reflection Questions

Given your discussion on programming driven by student as do'ers & designers, ask your team the following questions:

- Are we doing enough of this for our youth? Do we want to do more of this for our youth?
- What does the Student Affective Survey data tell us about our students in this area?
- How do the cross-cutting themes of supportive learning community and cultural perspectives contribute to this focus?
- What opportunities exist for increasing this focus?
- What supports, resources, or professional development would help us address this better?

3. Core Programming Element: Students Apply Learning in New Situations

Why Students Applying Learning in New Situations is Important

A 2012 National Academies of Science report on 21st Century skills referred to "deep learning" as the ability to transfer what has been learned in one situation to another one (NRC 2012). This is considered by some the true meaning of having learned, when it can be applied in a novel situation or context. But this so-called far transfer needs to be practiced, ideally by allowing the learner to first practice within the context in which he/she encountered the new learning, and only then make them apply a more established ability or skill to a novel situation or context. To read more about this topic refer to National Research Council (2012, pp. 69-100).

Please review your responses to the following Self-Assessment questions

- 10 (13 -18) How often will youth do each of the following…
    - Explain the reasoning behind an idea
    - Write about what was observed behind an idea
    - Give some form of presentation to the group
    - Use evidence to support or refute a claim
    - Create a physical model of a scientific idea,...
    - Use models or model thinking to explain observations or data
- 25-27

Discuss Important Considerations

- While we need to provide opportunities for students to demonstrate understanding and practice skills in similar situations in order to build competency/proficiency, we often forget to see if they truly understand the concepts and are able to use the skills in different situations.

[Type here]

- Students are used to answering short, recall questions including recounting what happened, describing what they experienced or retelling a story but these don't assess their actual understanding.
- Shifting from recollection-only to putting youth in the empowered position to wield their knowledge to solve problems and explore concepts in contexts they have not yet experienced provides opportunities to demonstrate their actual understanding.
- The balance between activities that use the same skill in a similar situation and activities that use the same skill in a new (or modified) situation will be dependent on many factors including length of program, nature of program, types of activities, etc.

Reflection Questions

Given your discussion on programming that includes opportunities for students to apply learning to new situations, ask your team the following questions:

- Are we doing enough of this for our youth? Do we want to do more of this for our youth?
- What does the Student Affective Survey data tell us about our students in this area?
- What opportunities exist for increasing this focus?
- How do the cross-cutting themes of supportive learning community and cultural perspectives contribute to this focus?
- What supports, resources, or professional development would help us address this better?

4. Core Programming Element: Relevant to Students & Community-based

Why Relevant to Students & Community-based is Important

According to a 2015 National Academies of Science report, "commonly, young people's ideas about STEM reflect cultural models that include images of obsessive genius scientists working lonely late night hours in their laboratories. Such cultural models make STEM less appealing to many youth who envision their future life's work as addressing significant issues in their communities. A major goal of STEM education therefore is to help youth understand the relevance of STEM to the worlds they know, so they can understand the utility and value of STEM and how it is situated in meaningful social contexts" (p. 20). Out-of-school STEM programs have an opportunity to address this issue by connecting youth to relevant settings and contexts within their communities that "treat youth as knowledgeable and capable, thus supporting youth to intellectually, socially, and emotionally to fully participate, contribute, and develop as members of the STEM learning community" (p. 21). To read more about this topic refer to National Research Council (2015, pp. 20-22).

Please review your responses to the following Self-Assessment Tool questions

- 16 - 24

[Type here]

Discuss Important Considerations

- Just because it's in the community, doesn't mean it will be relevant to the student; for example, your community has a golf course but referencing the game of golf may be meaningless if the students have never played golf or seen the game of golf.
- On the other hand, having students investigate a common or frequently utilized community space, such as a skate park, might provide highly relevant learning opportunities.
- Highly relevant topics may often involve issues affecting the families and youth who live in the community.

Reflection Questions

Given your discussion on programming relevant to students, ask your team the following questions:

- Are we doing enough of this for our youth? Do we want to do more of this for our youth?
- What does the Student Affective Survey data tell us about our students in this area?
- What opportunities exist for increasing this focus?
- How do the cross-cutting themes of supportive learning community and cultural perspectives contribute to this focus?
- What supports, resources, or professional development would help us address this better?

References and Resources for Further Reading

Ciechanowski, K., S. Bottoms, A. Fonseca, and T. St. Clair. 2015. Should Rey Mysterio drink gatorade? After School Matters. Spring Issue: 29 - 37.

Fenichel, M., and Schweingruber, H.A. (2010). *Surrounded by Science: Learning Science in Informal Environments*. Board on Science Education, Center for Education, Division of Behavioral and Social Sciences and Education. Washington, DC: The National Academies Press.

National Research Council. (2012). *A Framework for K-12 Science Education: Practices, Crosscutting Concepts, and Core Ideas.* Washington, DC: National Academies Press.

National Research Council. (2012). *Education for Life and Work: Developing Transferable Knowledge and Skills in the 21st Century.* Washington, DC: The National Academies Press. Doi: 10.17226/13398.

National Research Council. (2015). *Identifying and Supporting Productive STEM Programs in Out-of-School Settings.* Committee on Successful Out-of-School STEM Learning. Board on Science Education, Division of Behavioral and Social Sciences and Education. Washington, DC: The National Academies Press.

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Self-Assessment Results Guide

Student-Driven

Student as Do'ers & Designers

[Type here]

Students Apply Learning in New Situations

Relevant to Students & Community-based

[Type here]

Link to program characteristics survey

1. Were the [30 or 40 depending if you are a returning educator] hours of professional development just right, too much, or not enough and why?

2. What was the most valuable professional development opportunity?

3. Of the PD opportunities that you participated in, please describe how they helped you provide high quality STEM learning opportunities for youth (include specific examples when possible):
    i.   the Learning Communities (Partnership in STEM, Do'ers and Designers Workshop, Trauma-Informed Practice, or Making it Matter - Relevance)
    ii. Monthly Webinars
    iii. NGSS Consulting
    iv. One all-program event (March 5-7, 2018)
    v.   Program self-assessment process (survey and follow-up)

    b. How might we improve
        i.   the Learning Communities
        ii. Monthly Webinars
        iii. NGSS Consulting
        iv. One all-program event (March 5-7, 2018)
        v.   Program self-assessment process (survey and follow-up)

4. Which of the following NGSS practices did your program focus on THE MOST? For those practices selected, please describe what worked well and what was challenging?
    a. Design, test and redesign their own engineering solution
    b. Observe and ask questions about the world around them
    c. Design and conduct their own investigations
    d. Use charts/graphs/computer simulations to display/analyze data
    e. Create and use models to explain/predict (models may include diagrams, drawings, 3-D figures, analogies, computer simulations, and mathematical representations)
    f. Explain and defend their thinking using evidence (evidence may include observations, numerical data, and/or models)

5. Did your program provide opportunities to highlight or connect to STEM careers and/or STEM professionals? If yes, please describe.

6. Were community members involved in the program? If yes, please provide examples of who they were and their role in the program.

7. Of the 4 Core programming areas, which element(s) did your program try to incorporate the most?
      i.   Students are do'ers and designers
      ii. Activities are place and community-based (relevance)
      iii. Youth interests drive programming
      iv. Youth apply their learning to new situations

   Why did you focus on this area or areas? Give a specific example(s) of this in your program.

8. Did youth have opportunities to practice the skills they learned during your program, either in a modified situation (same skill, similar situation) or within a new situation (same skill, new situation)? Explain or provide examples.

9. On a scale of 1-10 (no/little support to lots of support), to what degree did SBS support changes to your programming this year? Will those changes continue next year (or into the future)? Please think about the 4 Core principles.

   a. Please describe the changes that you made and/or provide an example of such a change (e.g., did you expand or grow your program or modify your program activities?)

   b. Please describe how the changes improved the experiences for your youth

10. Thinking beyond Professional Development opportunities, how well did STEM Beyond School provide you and your program opportunities to reach out to learn from others or share your experiences with other programs?

   a. Please provide an example of such an opportunity

   b. Was there a missed opportunity that SBS could have supported? If so, please describe.

11. On a scale of 1-10 (not at all to very supportive), to what degree did participation in SBS Network **provide a forum for you to learn from and share with other educators**? Consider **PD opportunities** (e.g, Communities of Practice sessions, consulting support, webinars, workshops, etc...) and **events** (e.g., regional and the statewide event).

    a. Please explain your rating and share specific examples

    b. Please provide an example of a new relationship or connection that has been instrumental in helping you to improve outcomes and opportunities for your youth

12. Thinking about STEM Beyond School, we want to know your ideas as we move this project forward for all programs in the future:
    a. What should we continue to do or support?
    b. What should we stop doing or supporting?
    c. What should we modify or change in what we are doing or supporting?

13. Thinking about your specific program, what supports would you need to continue to improve your programming moving forward?

14. Thinking about the use of student surveys,
    a. How was the process of administering the Student Surveys?
    b. How helpful did you find the report? Were the results what you expected? How did you use the results?
    c. What challenges did you experience in using or interpreting the results?

15. Is there anything else you want us to know?

Thank you for being part of SBS this year!

Default Question Block

This short survey is for SBS program providers to fill out either just before or just after their exit interview. The purpose of this short survey is to quantitatively characterize the nature of STEM Beyond School programs and effective practices.

Thank you for your time!

What is your site code?

What is your organization or programming location?

How often did YOUTH do each of the following in your STEM out-of-school programs? Please choose the category that represents your best estimate.

	Rarely or Never	Occasionally	Often	Every session or almost every session
Choose projects or activities	○	○	○	○
Design and conduct their OWN investigations	○	○	○	○
Construct or build their OWN solution to a problem or challenge	○	○	○	○
	Rarely or Never	Occasionally	Often	Every session or almost every session

	Rarely or Never	Occasionally	Often	Every session or almost every session
Create and use models to explain or predict (models may include diagrams, drawings, 3-D figures, analogies, computer simulations, and mathematical representations)	○	○	○	○
Explain the reasoning behind an idea	○	○	○	○
Defend their thinking using evidence (evidence may include observations, numerical data, and/or models)	○	○	○	○

How often did you (as the instructor) do each of the following in your STEM out-of-school program? Please choose the category that represents your best estimate.

	Rarely or Never	Occasionally	Often	Every session or almost every session
Use open-ended questions to stimulate whole group discussion	○	○	○	○
Have youth work with each other in small groups	○	○	○	○
Support youth to question each other in respectful ways	○	○	○	○
Encourage youth to explain concepts to one another	○	○	○	○

	Rarely or Never	Occasionally	Often	Every session or almost every session
	Rarely or Never	Occasionally	Often	Every session or almost every session
Use STEM concepts to explain natural events or real-world situations (connecting what youth are learning to real-world situations)	○	○	○	○
Talk with youth about things they can do at home that are similar to those done in your program	○	○	○	○
Facilitate sharing of youth's relevant STEM prior knowledge or experience	○	○	○	○
Co-learn together with your youth	○	○	○	○

Did you connect your students and/or their families to additional STEM learning opportunities (e.g. providing flyers about an event in the community that was related to program content) outside of your program? If so, check all that apply.

☐ Museums

☐ Websites

☐ Activity Ideas for Family/home settings

☐ Nature places (parks, etc.)

☐ Movies

☐ Events or Programs at Colleges/universities

☐ Community programs or events (e.g., library)

☐

Other

Guidelines for facilitating youth feedback about their experience

Goal: To elicit feedback from youth to help you evaluate the impact of your program in terms of STEM learning, what youth liked and disliked about the activities offered, and what aspect, element or experience associated with the program was effective in achieving potential outcomes.

Rationale: This reflection exercise will allow youth to give your program a "grade" and let you know what they liked and disliked about it as well as what they learned. Results can be used to better understand youth learning in informal STEM programs and can inform changes/improvements to the program in the future. Seeking feedback from youth about their experience is also an essential programming element that provides youth a structured opportunity to provide feedback and have their voice heard. It also indicates your desire to have youth help you shape the next cohort's experience in a positive way, creating a sense of connection and empathy with those who follow in the youths' footsteps.

Methods: We suggest you audio-tape youth responses to your prompts so you have them available to listen to after the exercise. If you have more than 12 youth in your program, allow youth to first reflect in smaller groups of 3-4 to generate reflections together. This allows all youth to speak and share, encourages those less likely to speak up in a large group to have their voice heard, and serves as a filter. After sufficient small-group reflection time (10 min) bring the whole group together for the discussion. The whole process should take 15-20 minutes (maybe a little longer if you allow for small-group discussions first), and could take place before you administer the year-end survey with the students. We suggest creating a celebratory atmosphere for the day during which youth provide feedback to the program, with special snacks and other fun activities after the feedback activities!

Instructions: Use the following prompts as a guideline for directing the reflection activity. You want youth to feel "safe" to offer criticism as well as compliments. We suggest not using loaded or abstract words such as "learning." Rather ask what youth took away from the experience and how they might view the world differently after participating in the program. Feel free to ask follow up questions that encourage youth to go deeper and more explicit in their answers. For instance, if someone were to mention that they liked the field trip, ask what about it they enjoyed. Sometimes asking for an example can help youth articulate a thought that is difficult for them to explain in more detail or depth.

Data collection: After youth have reflected together as a group, ask them to write down their own personal answer to **prompts 2 and 3**. Have them put their name on the papers as well and then put them into an envelope that the educator seals so youth can be completely honest. We suggest this reflection activity be done twice during the program—once around mid-way through (optional) and once at the end (required).

Sample introductory prompt:
You know how you get a grade in school – this is your opportunity to give me/us/the entire program a grade – please be honest so you can help us make the program better in the future. (Could have facilitator turn around and one of the kids count how many A, A-, B+, B, etc. were given).

More specific prompts:

1. What was your favorite activity and why? Your least favorite and why? What other activities would you have liked to do?

2. **What will you take away from this experience? Did you benefit in some way? How?**

3. **Do you think about [things] differently since participating in the program? (Replace [things] with something specific from the content/major theme(s) of your program. For example, if a major theme was water quality, you might ask if they feel differently about rivers/lakes)? Tell me more about that.**

4. Is there anything new or exciting you discovered during the program?

5. Have you talked about your experience with others (e.g. parents, siblings, and friends)? What did you tell them?

6. How could the program be improved in the future? (Prompt youth for specific ideas.) What might be changed? But also: what should certainly stay the same (because it was great)?

Facilitator reflection: Please jot down your own impressions of what you heard after this feedback exercise and return it in an email message or in the same envelope with the youth responses.

Contacts: If you have any questions or need help obtaining a recording device, please contact Nancy or Kari (see below). Thank you!

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