Nuts and Bolts: Organizational and Program Characteristics of Youth Out-of-School-Time Programs Focusing on Science, Engineering, and Technology

Report to the Noyce Foundation

October 2012

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In the past decade, tens of millions of dollars have been spent by private and public sources on out-of-school-time (OST) programs. These types of programs are offered after school, on weekends, and during summer and have touched the lives of many young people. While many afterschool programs offer some science (Learning Point Associates, 2006; Chi, Freeman and Lee, 2008), most offer relatively few hours of science-related programming (Chi, Freeman & Lee, 2008). Yet programs that focus more intensively on science, engineering and technology[1] may be more likely to contribute to broad national goals such as increasing the size and diversity of the STEM workforce as well as offering supportive, enriching experiences for youth.

Proponents argue that OST venues are ideal locations for youth to engage in and explore science, engineering, and technology. Researchers and evaluators have begun to identify a range of positive student outcomes from science-focused OST programs. These programs have been shown to enhance science learning for youth and build their scientific and technical skills (Bleicher, 1996; Bell et al. 2003; Ritchie & Rigano, 1996; Bouillion & Gomez, 2001; Diamond et al., 1987; Etkina et al., 2003; Fadigan & Hammrich, 2004; Stake & Mares, 2001). Extended and creative exploration of science concepts outside of the constraints of the school day has also been shown to spark young people's interest and curiosity and increase their confidence (Barab & Hay, 2001; Diamond et al., 1987; Bouillion & Gomez, 2001; Stake & Mares, 2001, 2005). Some youth also experience shifts in identity and begin to see themselves as scientists or see science as relevant to their daily lives (Diamond et al., 1987; Fadigan & Hammrich, 2004; Rahm et al., 2005; Richmond & Kurth, 1999). Recently, researchers have begun to explore longitudinal outcomes of OST SET programming, suggesting that youth participants have a greater likelihood of pursuing STEM undergraduate degrees and careers than non-participants (Afterschool Alliance, 2011; Chi et al., 2011). Collectively, these studies have broadened our understanding of

[1] For simplicity, we refer to these collectively as "science-focused" programs.

how youth engage with science in the afterschool space and how these experiences may benefit youth.

So far, most studies of youth outcomes have been small in scope, often focusing on a single program or organization. This is no accident: rigorous, large-scale studies of the OST SET arena are difficult to conduct because of the variety of programs and populations served, attrition of participants, the challenge of selecting an appropriate comparison group, and variability in quality of implementation (Bevan & Semper, 2006; Friedman, 2008; Halpern, 2005). Because of this lack of rigorous research and evaluation, many critical aspects of OST programs have yet to be investigated. Out-of-school time programs with STEM curriculum and OST high school programs have been identified as two areas in need of further study (McClure & Rodriguez, 2007).

Before larger studies involving multiple science-focused OST programs can be designed, a good description of the nature and variations in such programs and their key features is required. As a beginning step toward understanding this variety, several recent studies have mapped segments of the SET OST community and have begun to generate insight into common program characteristics and concerns. For example, a recent survey of SET programs serving older youth suggested that the majority of these target underserved students (Porro, 2010). Programs for older youth typically include teamwork, inquiry-based learning, career awareness, and mentoring. An effort to map the diverse portfolio of projects funded by the National Science Foundation's Innovative Technology Experiences for Students and Teachers (ITEST) program documented that many of these projects rely on partner organizations and a mix of volunteers and paid staff to serve varied audiences including educators, researchers, youth, and policymakers (Parker et al., 2010). And a study of youth science programs in museums and science centers found that many science center programs serve older youth, provide adult mentors, and encourage youth to teach the general public or mentor younger students (Sneider, 2010). To date, these mapping efforts have focused on one segment of the OST SET arena, and have not attempted to study the national landscape of OST SET programming. Yet greater understanding of the scope and characteristics of OST SET programs is needed to identify "best practices" and program models for dissemination and scaling, to craft in-depth studies of youth outcomes, and to identify what local and national opportunities may exist to deepen and broaden youth access and participation.

Our study, Mapping Out-of-School-Time Science (MOST-Science), examines a national sample of OST programs focused on science, engineering, and/or technology. Thus our research questions are:

- *How can we describe the landscape of U.S. science-focused OST programming?*
- *How do programs vary by activities, populations served, duration and frequency, desired outcomes, and other key factors?*
- *What patterns in these variables help to characterize current program offerings and define areas of future opportunity?*

In this paper, we describe findings from the MOST-Science study. We discuss the characteristics of a national sample of OST SET programs and their home organizations, including aspects of program design, structure, content, funding, staffing, and youth audience.

Study Methods

Our mixed-methods study incorporated a program questionnaire, in-depth, semi-structured interviews, and document and web site reviews. The document and web site reviews laid the groundwork for the study. The program questionnaire was designed to elicit information from OST program leaders about program design, resources, content, and staffing. In-depth interviews were conducted with youth OST science program directors and other well-placed leaders and observers in the field. Interviews explored in greater depth the same issues as the program questionnaire, in addition to soliciting participants' views of the culture and future directions of the OST science field, OST policy, and other "big picture" issues.

Document and web site reviews

To begin to develop a categorization scheme of the characteristics and features of OST SET programs, we conducted extensive reviews of the research literature, white papers and other relevant documents, and program web sites. We identified a number of programs serving older youth that had conducted rigorous research or evaluation of their outcomes. We also searched the web sites of members of the Association of Science and Technology Centers (ASTC), the Association of Zoos and Aquariums (AZA), the Coalition for Science Afterschool (CSAS), and the National Girls Collaborative Project (NGCP) to identify promising programs that provide extended SET learning experiences for older youth. Our preliminary findings from these document and web site reviews about program content and audiences informed the development of the questionnaire and interview protocols.

Semi-structured interviews

Interviews were conducted with 53 OST SET program providers and leaders in the field. The interview sample was selected through "snowball sampling" (Patton, 1987; Heckathorn, 1997) in which we asked well-placed individuals in the field to suggest sites or programs, and other potential interviewees. Interviews were conducted from spring 2010 to fall 2011. We invited 85 people associated with the field of OST science education to participate in a telephone interview; 53 accepted for a response rate of 62%. Digitally recorded interviews lasted 30-80 minutes. Interviews were transcribed verbatim and entered into NVivo 9 qualitative software for analysis. Overall, 35 participants (65%) were program directors or staff, 13 participants (25%) were well-placed leaders in the OST science field, two interviewees (4%) were OST science researchers or evaluators, and three (6%) provided professional development or curriculum resources to the OST science field.

Respondents, most of whom have been involved with a particular institution or OST program, told us about the goals and objectives of their programs, their target audience and the demographic makeup of their student population, and the outcomes they had observed among participants. They described in detail the kinds of science content and "hands-on" activities in which students engaged. Respondents also talked about staffing, funding, resources, infrastructure, and evaluation. Leaders in the afterschool or OST science arenas provided valuable perspectives on educational policy and the larger field of OST science education.

Questionnaire development

While the goal of the interviews was to gain a broader view of the field from policy leaders, and to gain a wealth of information about a limited number of programs, the goal of the questionnaire was to gain basic information from a broad set of programs. Questionnaire items were developed based on our research questions, our findings from document and web site reviews, and on data from interviews. The items were reviewed by several leaders in the OST science community; the revised version was then piloted by several program directors, who shared their comments in think-aloud interviews. Based on their feedback, items were further refined and simplified. The online questionnaire was developed in Filemaker Pro software (version 11) and implemented from a server using FileMaker Server software and its Instant Web Publishing feature.

The questionnaire distinguished between the host organization and the one or more programs it runs. It included sections addressing:

- the organization's location and type, and the respondent's position within the organization,
- the organization's connections: partnering organizations, funding sources, involvement in national networks, and engagement in program evaluation,
- six questions used to screen programs for their fit to our sampling criteria (see below),
- basic data about the program: its title and history,
- program audience: grade level, special targets (e.g. girls, students with disabilities), application process, demographics,
- program structure: fee structure or stipends, scholarships, meeting schedule and frequency,
- program content: nature of staff, staff training, STEM content and activities, and
- any arrangement of programs into "ladders" or sequences for youth progressing in age and ability.

Altogether, the questionnaire included 126 items in 10 main sections. Because many questions depended on prior answers, respondents moved through the questionnaire in a non-linear fashion and did not answer all questions about each of their programs.

Sampling

We established six criteria to bound our questionnaire sample, including programs that:

- focus on science, engineering and/or technology (self-defined by user),
- include youth in (or entering) grade 6 or higher,

- engage youth with their peers and/or the public,
- involve youth for multiple sessions,
- have existed for one year or longer, and
- take place outside of school time.

In order to minimize individual respondents' effort, a negative response to any of these questions ended the questionnaire for that program. Respondents could enter multiple programs offered by their organization.

We selected these sampling criteria based on the markers of program quality identified in the research literature. We focus on the middle and high school years as the time when students' science interests may decline or strengthen, and when they begin to make decisions about their future careers (Tai et al., 2006). In naming our study MOST-Science, we use the term "science" broadly, including technology and engineering as well as life, physical, Earth and space sciences. Disciplinary distinctions are often not firm at the lower levels of this grade range, and may matter more to adults than to young people. But we exclude mathematics-focused programs based on our interest in hands-on investigation and design experiences as means of engaging youth. Finally, our choice to focus on group-oriented programs reflects our interest in the role of collaborative learning in youth outcomes.

The questionnaire was launched in November 2011 and closed in June 2012. We distributed the questionnaire through multiple mechanisms, trying to reach the widest possible study sample. Invitations were issued through:

- e-mail distribution lists and newsletters of national alliances and networks, and funders
- direct e-mail invitations to programs identified through web sites, directories, membership lists, and personal contacts
- our professional and personal networks of educators, scientists and engineers
- "MOSTcards" distributed at meetings and conferences
- social media, such as Facebook and Twitter.

In all, we sent nearly 2300 email invitations, over 1900 of which went to specific OST science programs. Over 300 additional invitations reached well-connected individuals working in informal, K12, afterschool and higher education, and diversity initiatives, across engineering and science disciplines. We know that some of these individuals shared our invitation with their own organizational, professional and personal networks; we also know that some programs received multiple invitations. However, we have no way to assess how many people representing how many programs received an invitation, and thus we cannot compute a response rate for the questionnaire. Our final data set includes 712 programs from 45 states, of which 417 programs (59%) met all six sampling criteria and answered one or more questions pertinent to this analysis. The sample size for any particular result varies, as not all respondents answered every question.

Analysis methods

For analysis, the data were exported from Filemaker Pro version 11 into Excel. We then cleaned these data, removing write-in responses (for future analysis) before importing the quantitative data into IBM SPSS version 20. We used SPSS to calculate means, frequencies, and percentages for the organization- and program-level data included in this analysis. We created dummy variables for categorical program-level and organizational-level variables and then used these dummy variables to conduct an ordinary least squares regression to analyze predictors of ethnic diversity of youth participation in OST SET programs.

Interview data were analyzed using domain analysis (Spradley, 1980) in which transcripts are searched for units of meaning. Groups of codes that cluster around particular themes are assigned to domains. Taxonomies are constructed linking domains to coded examples. Matrix tables of frequencies for responses on particular topics or themes add a dimension of comparison across domains and data sets, to identify differences among sub-groups in the sample or organizational types.

Results

We first report results on the regional distribution of OST science programs. We then describe the types of organizations contributing programs to our sample, as this categorization is used as an independent variable for examining other program characteristics and their variation. Finally, we report on programs' youth audiences, content, structure, and financial support.

Regional Variations in OST Science Programs

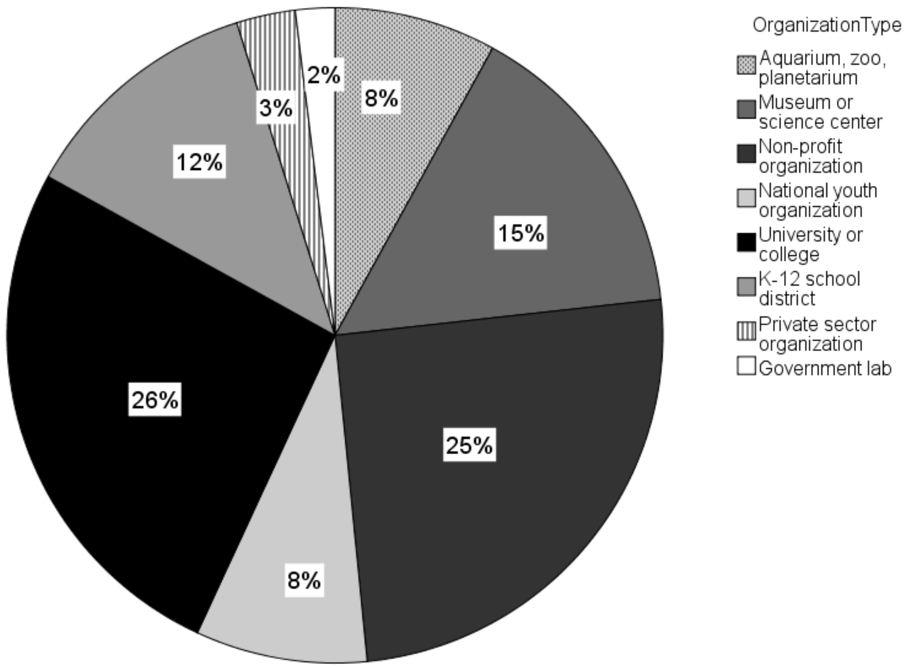
We collected data from a broad array of programs, as demonstrated in Figure 1. The national map highlights regional variations in the presence or absence of OST SET programs. For the most part, the East and West Coasts, the Southeast and the Midwest are well represented with OST youth science opportunities. On the other hand, the Rocky Mountain West, Southwest, and North Central regions of the country offer fewer OST science programs. Additionally, two programs in our sample were located in Alaska, and four in Hawaii. Not surprisingly, programs cluster near cities and highly populated areas, with fewer programs located in rural areas.

Figure 1*: Geographical Distribution of OST Science Programs (n=347)*

Type of Organizations Hosting OST Science Programs

We collected data from 417 programs and classified their host institutions into seven organizational types as shown in Figure 2. Respondents were asked to report on all of their organization's OST program offerings; some reported on a single program while others supplied data for up to six programs.

Figure 2: *Percentage of Programs by Organization Type (n=417)*

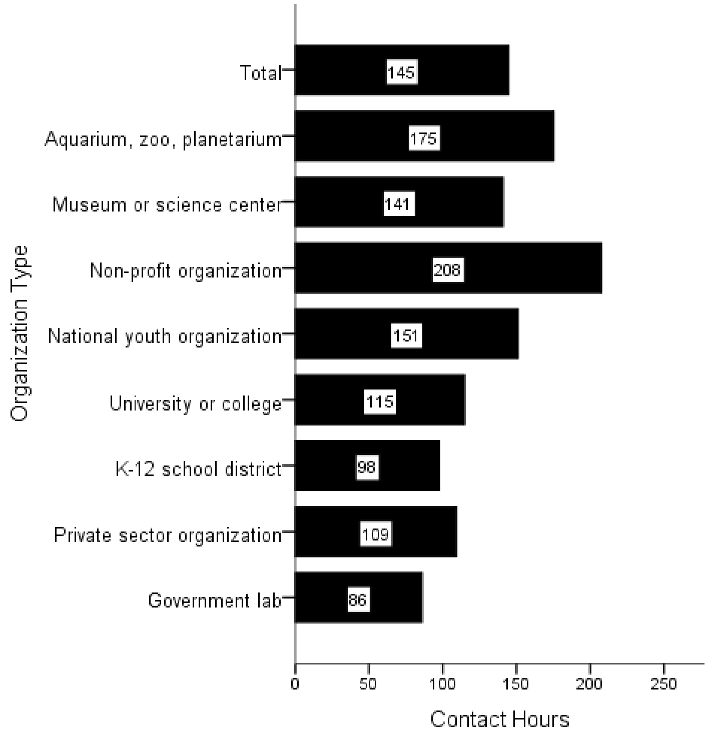


Roughly half of all programs in our sample were represented by just two organization types: universities and colleges, and non-profit organizations. Programs least represented in the sample were those hosted by private sector organizations and by government labs. The majority of programs offered by private sector organizations were summer camp programs, a fact that provides context to other results for this organizational type. Overall, we do not argue that this sample represents the broader distribution of OST science programs nationally, but the breadth of the sample does enable us to examine differences in programs by their organization type.

Contact Time for Youth Participants

We asked about the annual contact hours for each program's youth participants in terms of the experience of an "average participant." Some programs likely reported based on actual records of the program schedule, while other programs reported best guesses or estimates that include variation in a typical participant's choices. In the aggregate, approximately half of all programs reported that their youth participants experienced an average of 80 hours or fewer in a year, while half of all programs reported 80 hours or more. Approximately 25% of programs reported average annual contact hours over 200 hours. Responses ranged as low as 4 hours and as high as 740 hours.

Figure 3: *Average Annual Program Participant Contact Hours by Organization Type (n=350)*

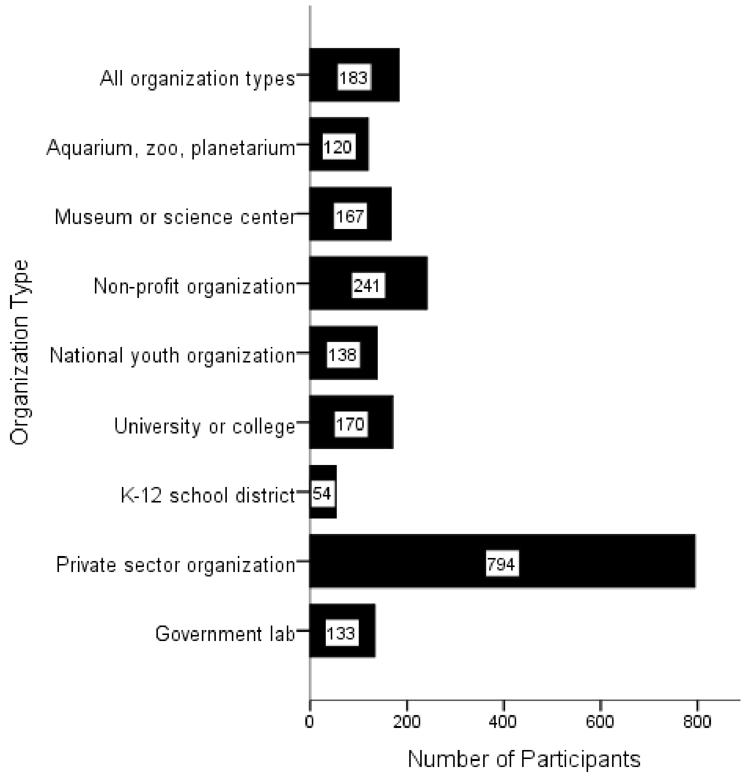


The average number of program contact hours was wide-ranging and differed by organization type. Nonprofit organizations provided programs with more contact hours than did any other organization type. Programs in two organizational categories, K-12 school districts and government labs, averaged 100 hours or less contact hours per year, with programs provided by government labs reporting the lowest average. Overall, contact time is high, indicating that many programs offer youth a science, engineering, or technology experience of substantial depth. However, reports of high contact hours also reflect our choice to exclude single-day programs or workshops from the data set.

Characteristics of Youth Participants

We asked organizations to report their annual youth population for each program they described. The average population for each organization type is shown in Figure 4. Private sector organizations showed a dramatically higher average annual population than all other organization types, at nearly 800. Approximately 90 percent of private sector programs were summer camps, which typically offer multiple sessions to a large number of participants. Non-profit organizations programs reported the next largest population, while programs offered by K-12 school districts served the fewest participants. These programs are likely limited to students at a particular school district, whereas other organizations may recruit from a larger pool of participants. Programs by all other organization types served similar numbers of participants per year, at 100-200 youth.

Figure 4: *Average Annual Program Population by Organization Type (n=341)*



Demographics of Youth Participants

We asked respondents to report the average demographics of their youth participants by gender and ethnicity. On average, most programs across organizational types served a high proportion of girls (56%). National youth organizations reported the highest proportion of girls (82%), while private sector, K-12 school districts, and government labs reported the lowest proportions, near 40%. All other organization types reported significant proportions of girl participants, indicating that many programs focus on engaging girls in science, engineering and technology.

Averages for each ethnic group, by organization type, are shown in Table 1. Because we describe average rather than actual program proportions, the percentages of ethnicities do not total to 100% by organization type. Overall, programs by nonprofit organizations served the most ethnically diverse populations, while programs by K-12 school districts and by aquariums, zoos, and planetariums served the least ethnically diverse populations. Programs by nonprofit organizations served the highest proportion of Black and Latino participants while government labs served the lowest proportion of Black and Latino youth.

Table 1: *Average Percentage of Youth Participants by Gender and by Ethnicity for Programs by Organization Type (n=327)*

Organization type	Girls	Asian	Black	Latino	Multi-racial	Native American	Other	White
Aquarium, zoo, planetarium	60.6	12.5	14.8	11.8	4.6	0.9	1.5	58.4
Museum or science center	57.9	9.6	25.6	16.9	6.0	2.2	4.4	49.0
Non-profit organization	56.2	8.3	35.6	33.7	8.2	3.0	6.6	26.6
National youth organization	82.3	3.3	19.6	28.3	6.6	3.7	3.3	48.4
University or college	57.8	11.6	19.9	17.5	4.9	3.2	2.6	49.3
K-12 school district	40.2	18.6	10.2	13.6	5.7	0.5	2.8	61.5
Private sector organization	40.0	23.7	9.7	10.4	11.8	2.6	7.0	49.8
Government lab	42.6	23.3	7.0	10.0	6.0	0.3	0.5	45.4
All organization types	56.1	12.0	22.5	20.8	6.2	2.4	3.8	46.9

Note: average percentages reported by respondents are presented in this table and do not total 100%

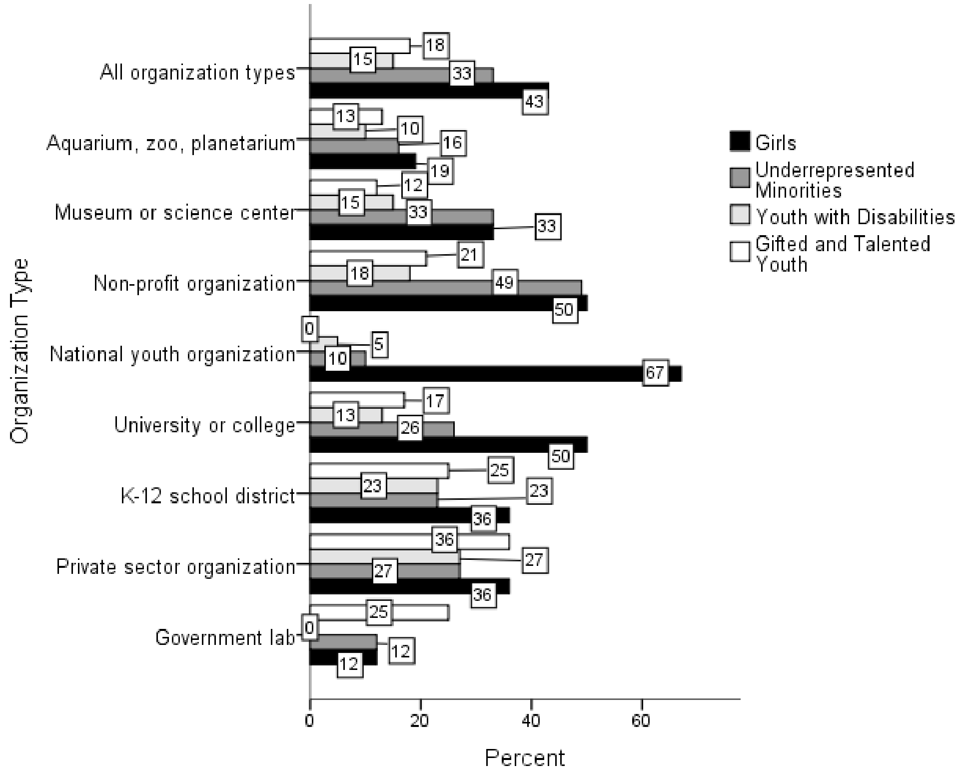
Target Youth Audience

We sought to understand whether and how organizations targeted specific youth audiences to their programs (Figure 5). Respondents reported on whether or not their program targeted any of several groups of interest, including girls, underrepresented minorities, youth with disabilities, and gifted and talented youth. The targeted audience may differ from a program's actual audience, depending on the success of its outreach and recruiting, and its choice to include non-targeted groups or not.

In general, girls were most commonly targeted, followed by underrepresented minorities, gifted and talented youth, and youth with disabilities. National youth organizations most frequently targeted girls, with 67% of programs thus directed. This reflects the gender-specific nature of some national youth organizations, such as Girl Scouts and Girls, Inc. Underrepresented minorities were targeted by programs across all organization types, with non-profit organizations targeting minority youth at the highest rates (49% of programs) and national youth organizations at the lowest rate (10%). Gifted and talented youth were targeted by programs of all organizational types except national youth organizations and government labs. Youth with disabilities were targeted less than any other group. They were not reported as targeted by any government labs, and were targeted most by private sector organizations (27%) and K-12 school districts (23%).

Overall, national youth organizations appear to more often identify girls as a target audience, while other organizational types had comparable distributions of target audiences. Government labs and aquariums, zoos, and planetariums had generally less defined target audiences, with no group targeted over 20%. In future work, we plan to look at these characteristics in relation to the organization's scope and mission, considering issues such as expectations of publicly funded institutions and the ability of organizations to target specific local needs.

Figure 5: *Average Percentage of Programs Identifying Specific Target Audiences, by Organization Type (n=350)*



Financial Support of Youth Participants

To understand the range of program practices around the financial support of youth, we asked organizations about program fee structure and scholarship opportunities (Table 2). Respondents were asked whether participants pay, do not pay, or are paid a stipend to participate in their programs, and whether or not scholarships were offered. Overall, the most common practices were to provide no-cost programming or to pay youth to participate. National youth organization programs were most likely to require participants to pay (67%) to participate in programs, but they also offered scholarships at a high rate (85%) relative to other organization types. Our findings show that private sector programs are the least accessible for low-income participants. Programs sponsored by private sector organizations often required participants to pay (38% of programs) and were least likely to provide scholarships (33%).

Table 2: *Fee Structure and Scholarship Offerings of Programs by Organization (n=260)*

	Fee Structure			Scholarship	
	Youth pay	Youth are paid a stipend	Youth do not pay	No scholarship offered	Scholarship offered
Aquarium, zoo, planetarium	9%	18%	73%	35%	65%
Museum or science center	26%	22%	52%	11%	89%
Non-profit organization	23%	13%	64%	40%	60%
National youth organization	67%	5%	29%	15%	85%
University or college	21%	32%	46%	11%	89%
K-12 school district	18%	3%	79%	47%	53%
Private sector organization	38%	0%	62%	67%	33%
Government lab	0%	29%	71%	50%	50%
All organization types	26%	17%	58%	26%	74%

Program Elements that Predict the Diversity of Youth Participants

We tested the association between various organization-level and program-level variables and the percentage of youth served by programs who are ethnic minorities (Table 3). Not surprisingly, the strongest predictor of underrepresented minority participation in OST SET programs was the purposeful targeting of these populations. Fee structure was also significantly positively associated with serving minority populations; that is, programs that did not have fees, or that paid youth to participate, yielded higher rates of ethnic minority participation than programs that had fees.

Other organizational-level variables were not significantly associated with the participation of youth from underrepresented minority groups. Purposeful targeting of minorities and fee structure explained roughly 50% of the variability in minority participation in OST programs, indicating that these factors are effective means of increasing minority participation in OST SET programs.

Table 3: *Regression Analysis for Numbers of Ethnic Minorities Served by OST Programs.*

Predictor	β	*SE*	*Standardized* β	*t*	*p*
Number of professional affiliations	-0.507	1.269	-0.047	-0.400	0.692
*Programs with no fee**	7.035	2.745	0.306	2.563	0.015
Organization type	-1.402	1.473	-0.113	-0.952	0.347
Number of public funders	1.570	1.416	0.130	1.109	0.275
Number of private funders	-1.725	1.185	-0.181	-1.456	0.154
*Programs with minorities as target audience***	31.390	5.248	0.780	5.981	0.000

β - unstandardized regression coefficient; *SE*- standard error; *standardized* β – standardized regression coefficient; *t*- test statistic; *p*- probability statistic. For further explanation, see Endnote (a).

R^2= 0.47; *significant result, $p<0.05$, ** $p<0.01$

In interviews, program providers affirmed that targeting specific populations increased the diversity of their youth participants. Program directors most often discussed targeting youth from underrepresented minority groups or low-income households. For the most part, employing specific recruitment practices for these groups resulted in youth participation rates over 50% for the targeted groups. Interestingly, some respondents who described their program's general success in recruiting underrepresented minority youth often described difficulty in recruiting a sub-group within that larger population, such as Native Americans or African-Americans. Likewise, the data from the questionnaire indicate that some programs based in certain types of organizations struggle to recruit underrepresented minority students, particularly Latino youth.

Nevertheless, successful programs in recruiting underrepresented minority youth had established relationships or partnerships with schools and community-based organizations in low-income or underserved neighborhoods. Many of these programs worked with local parents, teachers, or community leaders to reach out to the community and recruit youth. For instance, a program provider described community connections that have helped to recruit Latino students into their program.

> *We have a group of recruiters. We actually go out into the community, we find out who are those counselors in the school who are advocating for kids? Who are the migrant education leaders? Who are those teachers that are inspiring kids to look for different programs? We've developed a pretty good network of formal and informal providers that we work with directly. They will recruit the kids for us, and we work with them to make sure they have all the information they need, and they've got their parents for*

parent meetings. They're kind of like our agents on the ground who are telling the parents it's okay, and helping to gather the paperwork.

Content of Program Activities

To understand the content and specific activities in OST SET programs, we asked programs to select from a list of activities that they may use during their youth programming. In Table 4, we examine differences in reported program activities according to organization type. Most organization types emphasized learning specific science content, but K-12 school districts and government labs (88%) included specific science content in their programming slightly more often than other types of organizations. Almost all non-profit organizations (96%) used inquiry-based learning activities, while these were used less often by government labs (75%) and by planetariums, zoos, and aquariums (74%). Extended research design was not a common program feature for most organization types, with the exception of government labs (63%). The presence of practicing scientists at national labs most likely facilitates the inclusion of scientific research in youth programming. Exposure to careers was most common in non-profit organizations (92%) and universities or colleges (90%) and less common in K-12 school district programs (65%).

Youth development features, such as personal and social-skill building, were common across all organization types, particularly national youth organizations (100%), most of which emphasize youth development in their mission. Youth development activities were less common in government labs (75%) and for-profit programs (75%). Variations in program activities most likely arise from differences in organizational mission and program goals, as well as access to scientific expertise and resources.

Table 4: *Frequency of specific program content and activities by organization type (n=336)*

	Organization Type							
	Aquarium, zoo, planetarium	Non-profit organization	K-12 school district	Museum or science center	National youth organization	University or college	Government lab	Private sector organization
Learning specific science or engineering concepts	81%	87%	88%	83%	74%	86%	88%	75%
Hands-on science or engineering activities	81%	97%	95%	94%	95%	92%	88%	88%
Inquiry-based learning activities	74%	96%	79%	85%	79%	84%	75%	88%
Extended research or design	39%	55%	49%	52%	32%	45%	63%	38%
Exposure to science, technology and/or engineering careers	81%	92%	65%	81%	84%	90%	75%	88%
Science content linked with local, state or national standards	26%	71%	35%	44%	47%	31%	38%	38%
Help with homework	3%	37%	9%	21%	42%	15%	0%	0%
Intellectual skills-building	61%	85%	72%	87%	84%	81%	100%	75%
Technical skill-Building	35%	69%	77%	77%	63%	82%	63%	50%
Communication and presentation skill-building	71%	79%	74%	81%	89%	69%	75%	75%
Personal/social skill-building	94%	87%	81%	96%	100%	88%	75%	75%
Opportunity to share knowledge with the local community	60%	70%	42%	56%	74%	49%	50%	38%

Likewise, in interviews, the program activities discussed most frequently by program directors were the use of specific science content or concepts (91%), youth development (86%), role models (83%), hands-on learning (80%), authentic or real-world content (77%), exposure to careers (74%), inquiry-based learning (69%), and field trips (66%). It is not surprising that the two most common program elements were the introduction of specific science content and youth development. According to most program providers in our interview sample, the two go hand-in-hand and exemplify the mission of many OST SET programs.

> *It's important that we do all of this for science, but it's not just about science. But at the same time, I don't think we would get the same result in science, if we didn't have these other components, the personal and youth development components. I think we wouldn't be as exciting in the science component, and vice versa.*

Other essential features of OST SET programs include authentic or real-world content, and the opportunity to engage in extended scientific explorations. Many of the programs that targeted underrepresented youth sought to involve youth over a period of years in scientific activities that are relevant to their lives or local community. For instance, one program provider described a youth program offered by her organization:

> *The program has cohorts of kids who usually stay with it for three or four years, and those kids are doing actual scientific research. Usually it's water quality testing or other things like that…. They discovered that there was some illegal dumping in a local stream and they've been working with the EPA to try to get the violator brought to justice…. And it's definitely targeting kids from underrepresented neighborhoods and getting them engaged in scientific research, in their neighborhood, that's specifically relevant.*

Finally, the involvement of role models, such as scientists and engineers, was another important feature in OST SET programming. Scientists provided mentoring, content expertise, and career guidance and information to youth. Many programs also depended on the involvement of scientist volunteers for sustainability purposes, particularly programs that do not have trained scientists on staff. A representative of a national youth organization discussed the importance of professional scientists and engineers to their youth programming:

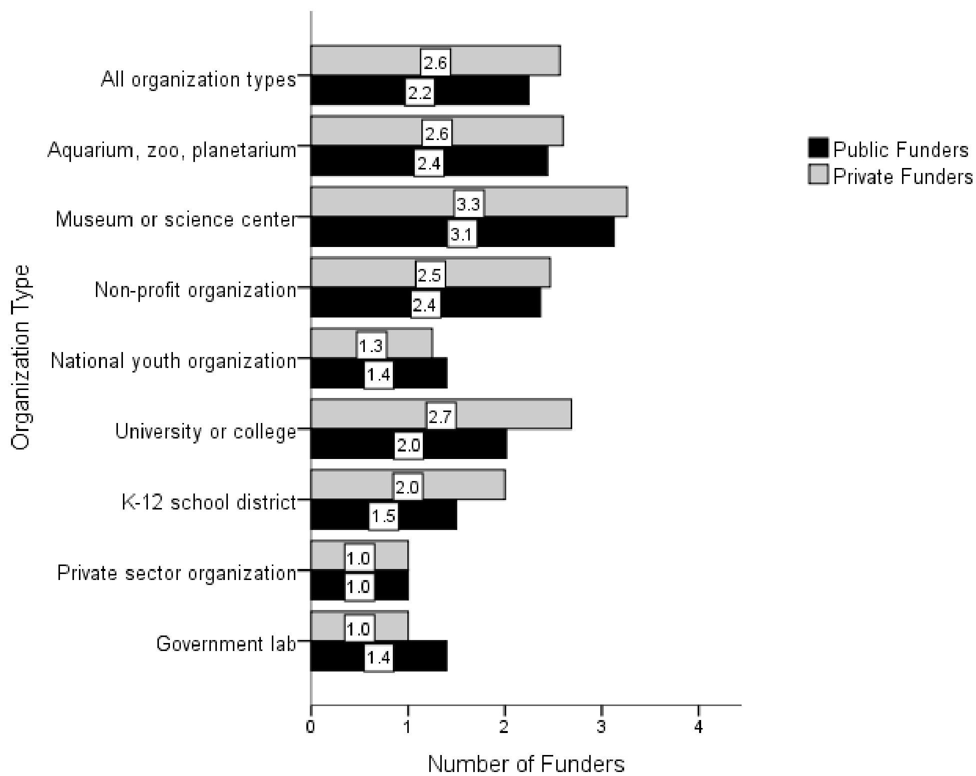
> *For our science programs, part of the sustainability is finding the volunteers. We are working on developing national and state and local partnerships with organizations like the Society for Black Engineers, all the scientific associations that have come to us and said, 'We have professionals, scientists or engineers, who want to work with kids and volunteer.' And so that's one of the things that we've been doing to really help programs to become more sustainable. Without volunteers, they're gonna just die out.*

External Support for Youth OST Programs: Funding and Networking

In addition to the financial support of youth, we asked organizations to report the support received by public and private funders (Figure 6). Overall, respondents reported that their programs were supported by zero to seven outside funding sources. On average, about half of the organization types were supported by more than two public and two private funders. The rest were supported by one or two public and private funders. In general, larger organizations were better funded than smaller organizations.

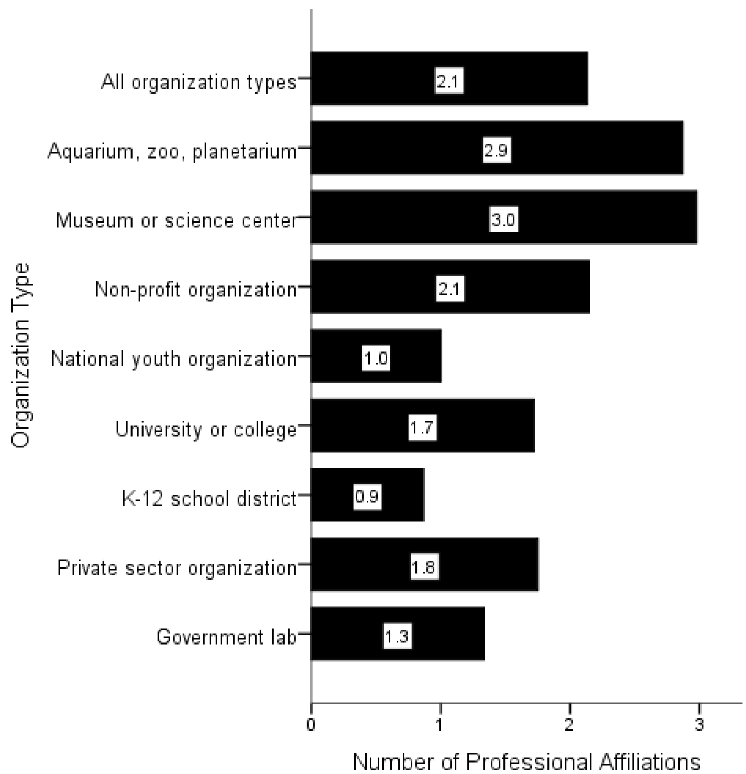
One interesting exception to this general rule is programs affiliated with national youth organizations, which averaged just over one public and one private funder each. This suggests an explanation for their common practice of charging youth to participate (as reported in the prior section). This may also reflect that external funding is sought by the national organization to develop curricula and train leaders, rather than by the local chapters or programs that responded to our questionnaire. It is also possible that programs sponsored by national youth organizations in our sample were not representative of all national youth organizations in this respect.

Figure 6: *Average Number of Program Funders by Organization Type (n=208)*



We also asked respondents to report on professional affiliations related to their organization and programs (Figure 7). On average, all organization types reported at least one professional affiliation, with a maximum of seven reported affiliations. Museums, science centers, aquarium, zoos, planetariums, and non-profit organizations averaged between two and three professional affiliations, while all other organization types averaged one to two professional affiliations. K-12 school districts, national youth organizations, and government labs appear less well networked than were other organization types that we studied.

Figure 7: *Average Number of Professional Affiliations (n=207)*



In interviews, program providers discussed the benefits of their professional affiliations and networks. All program directors in our interview sample were involved in at least one, if not multiple professional affiliations. Interviewees reported affiliations with the Coalition for Science After School, National Girls Collaborative Project, Association of Science and Technology Centers, Association of Zoos and Aquariums, statewide afterschool networks, and informal regional consortiums of OST science programs, among others. Program providers noted the importance of these networks for professional development, collaboration, and the exchange of ideas. Nevertheless, many still expressed a desire for more ongoing opportunities to engage with and learn from colleagues in the field. As one program director lamented:

> *But I think that has actually been one of the bigger challenges, is actually finding a way to collaborate and make it meaningful between ourselves and our programs and other programs. There also hasn't been a stage for all of us that run these kind of programs to be able to use each other as a resource, and that network doesn't quite exist.*

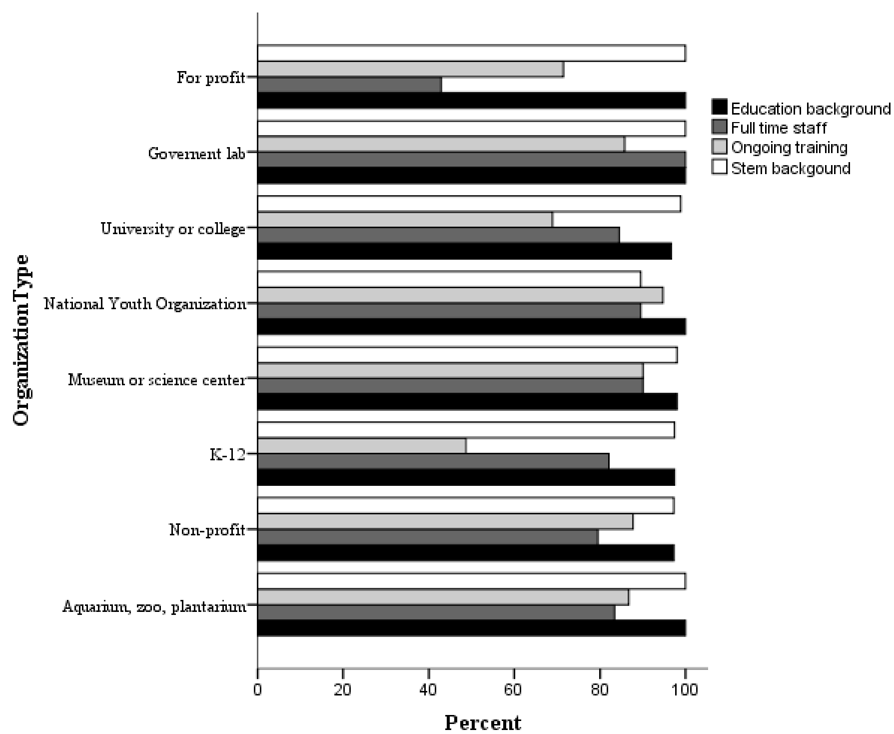
Staffing and Professional Development

We asked several questions about staffing and professional development within organizations. Organizations were asked if they had at least one full-time staff member. Almost all organizations (90%) that answered this question reported at least one full time staff member. Private sector organizations reported the lowest levels of full-time staff (43%), reflecting a reliance of summer camps on seasonal staff.

Almost all (99%) of organizations had at least one staff member with an education background, and 99% also had at least one staff member with a background in a STEM field. National youth organizations reported the lowest rate of staff with STEM background (90%). We did not gather data on the percentage of staff with educational or STEM backgrounds, only on their presence.

All organizations reported providing initial training for employees; however, the opportunities for ongoing training varied across organizational types. Roughly 50% of K-12 school districts provided ongoing training for program staff, while the average for all other organization types was better than 75%. The lower rate of staff training from K-12-based programs may reflect the use of teachers as staff who are assumed to have pedagogical and/or science content background.

Figure 8: *Percentage of Program Staffing Characteristics by Organizations*

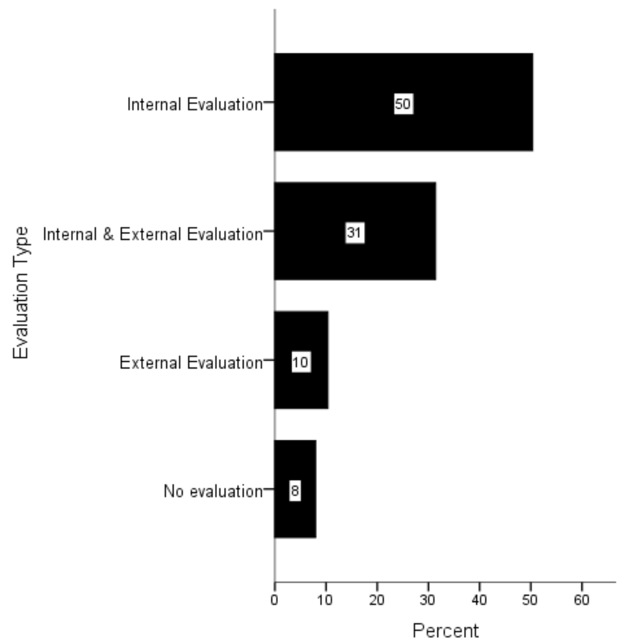


Overall, the organizations in our sample appeared to be appropriately staffed and trained, with two exceptions: private sector organizations had far fewer full-time staff, and K-12 school districts offered far fewer opportunities for ongoing training.

Program Evaluation

Program evaluation was relatively common among programs in our data set; indeed, only 8% of programs engaged in no evaluation activities at all. However, only 41% of programs had an external evaluator, as either the sole form of program evaluation or in conjunction with an internal evaluation. Fifty percent of programs conducted internal evaluation. While almost all programs engaged in some form of evaluation, there still seems to be a need for more wide-spread external program evaluation in the field of OST science.

Figure 9: *Aggregate percentage of evaluation activities for programs*



In interviews, many program providers noted that their evaluation efforts were dependent on resources and funding requirements. For instance, the reporting requirements of funding agencies, particularly federal agencies, often provided programs with the impetus and the resources to conduct an external evaluation. A program provider whose program received intermittent federal funding commented:

> *It's not that hard to collect the data, if you have the funding to have somebody to do it. And when we had the NSF funding, we had a lot of outcomes data as a result of the field test, and it probably hasn't changed enough so that they would be really different. NSF was impressed enough with that final report that they wrote the project up as one of their nuggets of the year.*

Some larger organizations, such as science centers, were able to support an in-house research or evaluation staff; however, smaller organizations struggled to conduct ongoing and rigorous evaluation of their programs. Smaller organizations often lacked the funding, resources, or the expertise to carry out evaluation. On the other end of the spectrum, national youth organizations struggled with evaluating the sheer size and scope of their activities and programming.

Another common theme that arose in interviews was the importance, and the difficulty, of collecting longitudinal data about student outcomes, as well as identifying appropriate comparison groups to determine if the program is having an effect. A leader in the field noted that the focus in the OST arena is shifting toward a desire for more evidence of learning and long-term impacts:

> *And then there's also been more of an emphasis overall on after-school programs on showing how we're directly affecting learning, and I think that made a difference as well. So I think the understanding that we need to be looking at this long-term, and even resources for that, will change*.

A final concern among both program providers and leaders in the field is developing appropriate metrics to determine success. For instance, a leader in the field commented on the need to select appropriate metrics, depending on program goals:

> *We're a little all over the map on that right now. For some people it is about academic success and grades; for some people it's about getting kids interested in science; for others it's getting kids to have a more positive view of scientists and the possibility of seeing themselves as scientists in the future. These are all valid goals, but then our success metrics need to be tied in to those goals.*

Discussion and Conclusion

This study is the first to distinguish characteristics of a national sample of youth OST science programs by organization type. While some of the similarities and differences reported here may be unsurprising to observers who work across organizational types, they may be less evident to those working within a particular sector. This may lead to misunderstandings or missed opportunities, especially because organizations may be networked primarily with others of similar type. Thus characteristics common across organizational types may go unrecognized, and useful lessons and expertise may go unshared across these informal boundaries.

Less predictable is the high variability in some characteristics across programs or organizations. Programs vary notably in the size and demographics of the youth populations they serve, and their interest or ability to target particular youth groups. The regional distribution of programs also varies substantially. Such data may suggest opportunities and unfilled niches for practitioners to pursue—for example, the lack of programs targeting youth with disabilities, or the relative absence of programs in rural areas and in the midsection of the country.

The data also point to interesting commonalities among programs. For instance, programs that successfully engaged high numbers of underrepresented minority youth employed common practices. They specifically targeted these populations and provided free programming or stipends to youth participants. Creating relationships with community organizations and schools in underserved neighborhoods were the most successful recruiting methods reported across programs of all types. This approach points to methods that may be successful with other underserved populations, such as youth with disabilities.

National organizations, such as the Coalition for Science After School and the National Girls Collaborative Project, provide networks through which programs can collaborate and share resources and ideas. Our data indicate that many OST SET programs were tapping into these networks. Yet at this point in time, these affiliations represent fruitful silos of engagement, rather than a broad community of practice across the diverse OST science landscape.

Program evaluation and professional development have often been cited as areas in which OST science programs need to build organizational capacity. Our data indicate that many programs were engaging in professional development, although this varied by sector, with K-12 school districts indicating less capacity for professional development in the OST arena. Further research is needed to determine the characteristics of professional development provided in the OST SET domain, and staff needs for this. Finally, most programs in our sample engaged in some type of program evaluation, although external evaluation was less common than internal evaluation. Some programs, particularly smaller ones, expressed a need for appropriate funding, resources, and training to successfully evaluate their programs.

While OST SET programs faced many challenges, the programs in our sample did not encounter the same level of staffing, training, or structural difficulties faced by typical afterschool programs in implementing science content and activities (Chi, Freeman & Lee, 2008; Noam et al., 2010; Means, House & Llorente, 2011). Our initial findings suggest that SET-specific programs may be preferable locations for engaging youth in OST science experiences, given the challenges faced by typical afterschool programs in providing and sustaining science programming.

Data from the programs in our sample also confirm the widespread view that the OST arena is an important location for increasing access to science for underrepresented groups, although program availability and diversity of youth participants varies by region and organizational type. Perhaps most importantly, these first findings shed light on the national landscape of OST SET programs—a potentially powerful source of science learning and engagement for youth—and lay the groundwork for future studies linking youth outcomes to program variables, such as staffing, target audience, program design, and science content.

Acknowledgments

We thank Melissa Arreola-Pena and Annette Brickley for research assistance and Linda Hardesty and Jim Hickam for technical assistance. We acknowledge Robert Tai for helpful conversations.

Several individuals offered expert advice at crucial junctures. We thank Jamie Alonzo, Kathleen Archuleta, Pam Garza, Andrea Hamilton, Sylvia James, Anita Krishnamurthi, Gabe Lyon, Karen Peterson, Irene Porro, Cary Sneider, Marley Steele-Inama, Maryann Stimmer, Carol Tang, and Kathleen Traphagen. We are grateful to many other individuals who provided valuable feedback and assistance along the way.

This work was supported by the Noyce Foundation, with additional support from the National Science Foundation Informal Science Education program (DRL-1010953). All findings reported and views expressed are those of the authors, and not of the funding agencies.

Endnotes

(a) In this model, β is an estimate of the change in percentage points of minorities served by a given program for a one-unit increase by a predictor. For example, programs that targeted minorities served minorities at 31 percentage points higher, on average, than programs that did not target minorities. A positive β means that that an increase in the predictor results in an increase in the outcome variable (percentage of minorities participating in programs). A negative β indicates that an increase in the predictor would result in a decrease in the outcome variable. *SE* (Standard Error) is the average error between observed and predicted values of the outcome variable based on each predictor.

The *standardized* β gives similar information, except that β is standardized for comparison with other predictors that are measured in different units. Values close to 1 or -1 indicate a strong relationship between the predictor and the outcome, and values close to zero indicate a weak relationship. Positive and negative values are interpreted the same as the unstandardized β.

t represents a t-test of statistical certainty and is used to compute the corresponding *p* value. Values of t less than 1.96 correspond to a 5% or greater chance ($p \geq 0.05$) that the results were due to chance, using the traditional criterion for statistical certainty of 95% or better.

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