Strengthening After-School STEM Staff Development

Jason Freeman
Coalition for Science After School

Rena Dorph, Ph.D.
Bernadette Chi, Ph.D.
Center for Research Evaluation, and Assessment

Lawrence Hall of Science
University of California, Berkeley

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Introduction

More than six million children in the United States spend an average of eight hours per week in after-school programs *(Afterschool Alliance, 2004).* The *Coalition for Science After School (CSAS)* website presents a compelling case for including science in out-of-school (OST) venues:

The Case for Science After School

STEM Pipeline. There is a decrease in students who follow STEM academic and career paths, even at a time when the nation's economy is becoming increasingly dependent on a STEM-literate workforce.

Changing Social Structures. Enrollment, especially of youth from populations historically underrepresented in STEM fields, is dramatically increasing in after-school programs as parents' working hours are increasing.

Advances in the Learning Sciences. There is growing awareness of the importance of nonschool learning experiences in generating interest, engagement, and capacity to know and do science.

Expectations from After-School Funders. Many supporters of after-school programs are asking more and more for evidence of academic achievement. STEM activities have the potential to support academic growth while being engaging and entertaining.

However, significant challenges exist as programs seek to include high-quality science learning opportunities as part of their offerings. Data from both *The Lay of the Land: Science Learning in Afterschool Settings* (Noam, Dahlgren, Larson, & Dorph, 2008) and the *Science in Afterschool Market Research Study* (Chi, Freeman, & Lee, 2008) demonstrate remarkably consistent findings and point to a number of these challenges:

Limited time for and access to quality science content

Many students in after-school programs spend little to no time engaging in high-quality science learning opportunities. Many programs offer limited opportunities for participants to engage in such learning. Both studies report that programs only occasionally or rarely offer science to their after-school participants. For those that do offer science regularly or occasionally, the percentage of students engaged in science and the frequency with which they participate in science varies widely. Further, there is reason to question the quality of the science materials used in most after-school settings, with over half the programs indicating that they "self-create" their activities and materials. Program leaders, however, would like support that would help them to increase the quality and quantity of science activities provided in their after-school settings.

Little staff science expertise or preparation

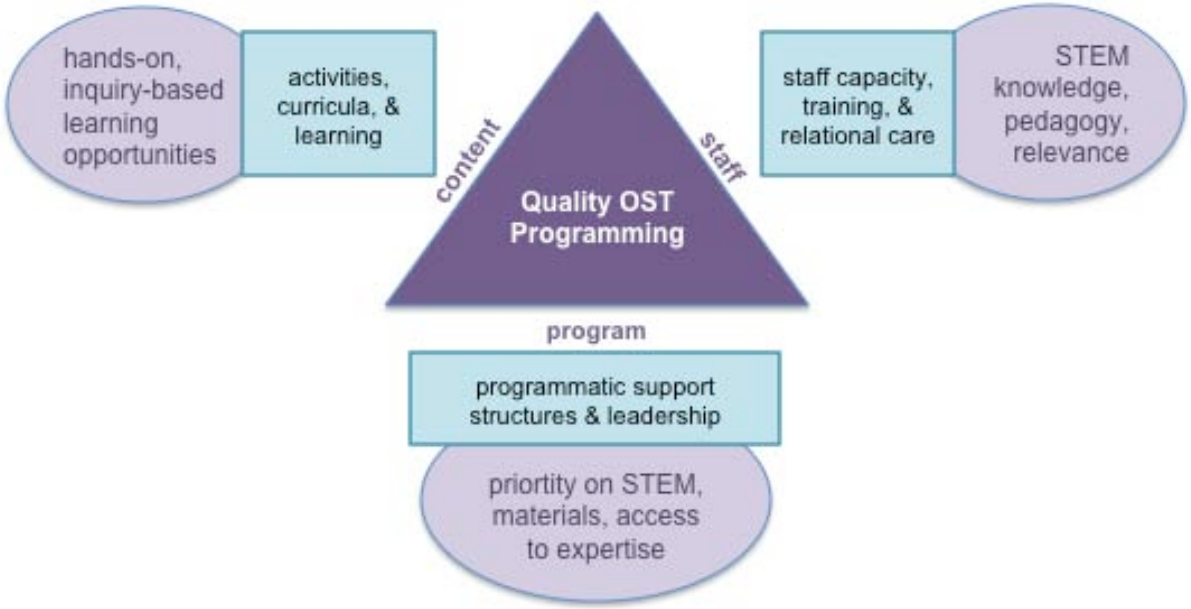
Survey responses (Chi, Freeman, & Lee) indicate that approximately 76% of programs do not have a dedicated science person on staff; typically, those who

teach science are youth workers with little science background. Further, both studies show that approximately half of the staff who facilitate science activities do not have the opportunity to participate in staff development opportunities related to these activities, or if they have the opportunity, do not avail themselves of it.

Supporting High-Quality Science Learning Opportunities

Noam (2008), in *A New Day for Youth*, argues that the features associated with high-quality out-of-school programs fit into three general areas: Activities, Curricula, and Learning; Staff Capacity, Training, and Relational Care; and Programmatic Support Structures and Leadership. To provide a framework for approaching quality OST programming, Noam suggests organizing these three areas in a triangle (see diagram to the right). He argues that there is a "need to address all three sides of the triangle to create high-quality OST programming." He refers to this framework as the "Quality Triangle."

This framework seems readily applicable to the case of science in after-school settings. For the purposes of this report, we have added a feature to Noam's framework (a shorthand, summarizing title for each of the sides of the triangle) and annotated the sides with more specificity related to the inclusion of science. We have included these in the diagram below.



This report examines one of the three sides of this triangle—staff—as it relates to supporting the inclusion of high-quality STEM learning opportunities in after-school settings. CSAS recognizes that the staff side of the *Quality Triangle* is critical to supporting quality science-learning opportunities for youth in after-school settings. In fact, in 2007, CSAS published a Blueprint that described the critical path to offering high-quality science, technology, engineering, and math (STEM) learning opportunities to youth during out-of-school hours. This Blueprint highlighted "building staff capacity (i.e., supporting the existing after-school workforce in delivering STEM learning experiences to youth)" as a critical area for action.

In order to examine the staff side of the triangle, we first summarize the current state of staff capacity in this arena. Next, we describe existing efforts to enhance staff capacity through staff development efforts and consider future directions. Finally, we recommend possible courses of action focused on increasing the capacity of OST staff who are engaged in providing science learning opportunities to program participants.

Staff Capacity in After-School

Current State of Staff Capacity in After-School

There are approximately two million employees and volunteers who staff after-school programs in the United States. In 2006, the Next Generation Youth Work Coalition (NGYWC), through work conducted by the *Forum for Youth Investment*, published the most complete information available on the existing "frontline youth workforce," referring to youth workers as those who work directly with youth for more than 50% of their job. The NGYWC report provides the following key findings based on information from two studies that gathered information directly from more than 5,000 youth workers (Yohalem & Pittman, 2006):

- The workforce is diverse, including a variety of ages, backgrounds, and prior education and work experience levels. There are two main points of entry—many youth workers enter the field young and often leave for other careers, while others enter in their 40s and 50s from other fields.
- Job satisfaction is high, but so is mobility. Youth workers stay primarily because they are committed to working with youth, but they leave due to a variety of factors, especially low wages and limited opportunities for advancement. Mobility is often to another organization, and not necessarily out of youth work.
- Employees may be part-time by choice (40%). However, 60% would be interested in full-time work if available.
- Advancement and formally recognized training opportunities are rare, though desired. Youth workers are more likely to seek training as incentives increase. Formal recognition, stipends, wage increases, and advancement opportunities are rarely attached to training.

- Youth work needs stronger support systems and networks, as well as greater legitimacy as a career choice.

As for the capacity of the staff actually tasked with teaching science in these settings, the *CSAS Market Study* indicates that over three-quarters (77%) of staff leading the science activities were after-school leaders who work directly with the youth rather than either after-school staff who specialize in science (29%) or staff from a local science partner (22%). (Total exceeds 100% because respondents could choose more than one option.)

Need for Staff Development[1] that Enhances Staff Capacity

According to the sources highlighted above, the after-school workforce is greatly diverse with a wide variety of ages, education levels, and both life and work experiences. Job satisfaction is high but so is turnover, and a significant percentage of youth workers (60%) would like full-time employment, as well as additional training and support. Also, staff members responsible for facilitating science learning often have little or no science teaching expertise or experience to support these efforts. While evidence suggests that instructors with youth development and literacy training can be effective instructors of inquiry science (Walker, Wahl, & Rivas, 2005), transforming the existing cadre of after-school instructors into effective facilitators of STEM learning will require significant attention to and investments in staff development.

At the same time, the existing opportunities and infrastructure for staff development related to science are insufficient. Both the *CSAS Market Study* and the *Informal Learning of Science in After-school (ILSA)* research efforts (Noam, Dahlgren, Larson, & Dorph) highlight this state of affairs. *ILSA* survey findings indicate that:

- Over half of the survey respondents (59%) from "typical" after-school programs reported that they did not offer staff professional development in science. Of the programs that did offer professional development in science, the sources were:
    - After-school programs or support organizations (36%)
    - Organizations that provide their own staff development (32%)
    - Schools, colleges, or universities (20%)
    - Informal science institutions (11%)
- Programs that reported offering staff development in science also reported (1) serving younger children and (2) using a purchased curriculum.

[1] There are many different definitions for staff and professional development. This document uses the broad definition provided by the Out-of-School Time Resource Center for *Promising Practices in Out-of-School Time Professional Development:* "activities, resources, and supports that help out-of-school time practitioners work with or on behalf of children and youth." Regardless of the approach, the goal of staff development is to improve performance, so that each individual is as effective as possible.

Further, 40% of programs surveyed in the *CSAS Market Study* indicate that a lack of staff training presents a significant challenge in providing science activities regularly to their participants. Programs surveyed as part of the *ILSA* study also reported several barriers to offering staff development related to science. These barriers include: insufficient funding (24%), focus on other content areas (22%), and lack of availability of science-related staff development in their area (17%).

The *NGYWC* advocates "a flexible and fair career pathways system" that requires, recognizes, and rewards competence with expectations that change with levels of responsibility. An effective professional development system can improve program quality, increase opportunities for youth workers to make their job a career or to learn skills that can be applied in other fields, and enhance the overall field by creating networks for sharing knowledge. The system includes: standards and competencies; learning resources; learning delivery system; compensation and career ladders; and research and evaluation (Stone, Garza, & Borden, 2004). Each piece of the professional development system contributes to effective transfer of skills to workers who directly support youth. This further depends on training for supervisors, a valuable but underprovided part of professional development. Managers and organizations should "support youth workers in ways other than just by acting as a role model." The system needs a wide range of support from local, cross-city and cross-state, and national providers in supporting both frontline staff and supervisors (Bowie & Bronte-Tinkew, 2006).

Designing Effective Staff Development

The dearth of empirical research in this field presents significant challenges as leaders and practitioners search for evidence of what might be the ideal content and structure of effective staff development in support of science inclusion. With the goal of documenting "best practices" in the field, the Noyce Foundation funded the *Coalition for Science After School (CSAS)* to gather existing research in this area and to form a *Community of Practice*[2] focused on the topic of after-school STEM staff development. In 2008, CSAS invited several of the leading experts in this field to participate in this *Community*. During a series of phone calls and in-person conversations at the *National Conference on Science and Technology in Out-of-School Time*, these experts shared their experiences and understandings about staff development. *Appendix B* documents key concepts raised during these meetings that are discussed throughout the following sections of this report.

[2] This *Community of Practice* is referred to throughout this document as the *Community* or the *Community* members. A list of *Community* members is included as Appendix A. Their conversations were the primary source for the content of this section of the document. Block quotes throughout the document are taken from these members' conversations.

Providers of after-school STEM staff development deal with a variety of challenges, target audiences, and expectations. They use a range of strategies to support their audience in providing science learning opportunities to youth. The *Community of Practice* addressed many of these issues, including: appropriate content, approaches that fit the available time and setting, types of staff development providers, and strategies for reaching audiences on a large scale. These aspects of staff development combine to create various strategies that can be applied to improve the delivery of after-school STEM nationwide.

The following section of this report synthesizes the expertise and practice-based wisdom shared through this *Community.* It also articulates some considerations for designing effective staff development opportunities for after-school staff.

Recognizing Challenges
It is important to recognize the challenges faced when providing STEM staff development for after-school staff.

The combination of very limited expertise (in both science and pedagogy) and high turnover poses significant challenges for staff development in after-school settings. Members of the *CSAS Staff Development Community of Practice* highlighted some additional challenges for staff development efforts, including:

- Logistical: limited in space, time, material, and equipment
- Attitudinal: (1) staff fear science, (2) staff view science as an academic subject only, not as enrichment, and (3) many staff are in after-school because they prefer to “play” with the kids rather than “teach” them

These challenges need to be recognized and addressed in the design of effective staff development opportunities.

Defining the Targeted Staff
Providers of after-school STEM staff development need to define and address their population.

The youth workforce is diverse in age, education level, and both life and work experience. All segments of this workforce will benefit from additional training and support. Some seek development opportunities primarily to improve their immediate job performance, while others are building a longer-term career and need support to develop skills that could apply beyond their current responsibilities.

Some after-school staff members are not actually "youth workers." Many after-school programs, such as federally funded *21st Century Community Learning Centers*, have classroom teachers as after-school instructors. Some programs hire staff with STEM expertise, such as school-day science teachers. It is important to support these providers, particularly by emphasizing the importance of youth

development in connection to STEM in after-school. However, this report focuses on staff development for those staff members without strong STEM backgrounds who make up the majority of the after-school workforce.

This audience is interested in education and youth development, but emphasizes a set of goals that differs from that of the formal education system. These instructors prefer a less-structured after-school environment. This mind-set is closer to the informal education field that is familiar to science educators. Effective staff development needs to provide more flexibility and less structure, to align with the expectations of the after-school educators. The target audience may be subdivided into three broadly defined staff populations and addressed accordingly:

1. Those who are receptive to STEM in after-school programs but understand neither the need nor the types of programs that can address that need. These after-school providers benefit from greater understanding of the potential positive impact of STEM activities for the youth and the community. They also must understand that use of high-quality resources and best practices is necessary to have a fully positive impact.
2. Those who resist STEM because of a perceived lack of expertise. Staff development for these individuals should focus on STEM processes and the need for student-centered activities that do not require instructor expertise.
3. Those who demand fun activities at the expense of a consistent set of materials and defined learning objectives. These after-school providers must understand the value of consistency, sequenced learning, and relevance to the school day. They require staff development connected to resources that make STEM programming both easy and effective.

Addressing After-School Staff Expectations Toward STEM
Providers of after-school STEM staff development must connect high-quality STEM learning activities with the existing context of the after-school field. Staff should feel comfortable when after-school STEM differs from school-day STEM.

Members of the *Community of Practice* represent a variety of approaches that connect to the existing after-school infrastructure in a different way. The most successful approaches account for unfavorable conditions, while also promoting incremental change in the larger system of after-school programming. The *Community* members reported that successful staff development often requires changes in the goals for after-school STEM (thus reaching all students, instead of a select few), changes in the attitudes of program managers (all staff can teach STEM), and increases in the amount of time dedicated to both staff development and STEM programming.

Efforts to change staff attitudes happen within the larger context of a changing after-school field. Relevant issues faced by after-school programs include:

- After-school programs feel pressure from the school-day leadership to limit the amount of time spent on after-school enrichment and focus on helping students pass standardized tests. This is also an equity issue, since the students who are struggling to achieve in school are even less likely than their peers to receive enrichment in after-school programs or at home.
- After-school staff and supervisors rarely have the time or expertise to plan for creative enrichment activities that go beyond keeping students safe and providing tutoring. Some programs have staff members who understand how to develop creative curricula and who recognize what external resources are available to them. However, such expertise is uncommon and is further limited by time.
- Many after-school staff consider science to be part of academics. They may not recognize the potential of STEM as enrichment. As a result, the children too begin to classify STEM solely as an academic, school-day subject, and they lose the connection between STEM and the world outside school.
- Some programs have only outdated or limited technology onsite; this constrains engagement of youth in creative, technology-based projects.

Content of Staff Development

Content of staff development varies depending on program objectives. Common elements of staff development opportunities include: exposure to key resources, some STEM content, emphasis on STEM processes, and providing a context for understanding STEM beyond the classroom. Staff development should focus on activities that are appropriate to promoting both STEM learning and youth development goals.

Staff developers should expose after-school staff to materials, supplies, equipment, and curricular resources that they can use with their youth participants. *Community* members contrasted these elements to staff development for classroom teachers. After-school staff need to be given any materials they need to implement their science projects and activities, because (1) they are so limited in their time to prepare activities that often "the first time they're looking at the materials is on the bus between school[3] and after-school," and (2) materials should be easily accessible, because then they will be familiar to the youth, who as a result will feel more comfortable with "doing science." Accordingly, the content of staff development for after-school STEM instructors should mirror the content of the STEM activities they use with their youth participants. Staff developers should model how engaging and relevant STEM learning can be for youth.

[3] The idea that youth workers may be traveling from "school to after-school" was mentioned often in the *Community of Practice*. Many youth workers also work in schools as paraprofessionals. Some are students themselves—in high school or college.

Staff development should include interesting STEM content as a hook, but trainings should focus more on process, methods, or an approach to teaching science than on learning the vocabulary and facts. These methods or approaches may help after-school leaders to ask good questions:

> *"It's framing good questions. They'll ask questions about what a student knows…ask questions as to why this works, why doesn't it happen this way? Well, what happens if I did that?—I tried that last time. Classroom teachers don't have time for that kind of discussion, so the after-school setting is particularly relevant for that. When we're doing staff development, that's what we try to do."*

In addition to STEM content and processes, understanding and appreciating the real-world value of STEM should be explicit in staff development. Connecting science with the world that the after-school staff find familiar helps them to understand their role as facilitators and relieves pressure to know detailed answers about STEM content. For example, staff development for *Operation SMART*, of *Girls Incorporated*, promotes positive attitudes towards STEM:

> *"…to create interest, to create confidence, and to really lay that foundation for learning to question and learning to inspire. The girls don't have the pressure to get a grade in science or math. In an after-school program, it's about learning at your pace; carrying out what you like; what you want to focus on; figuring out what are the real-life applications to this experiment that we're doing or this activity that we're doing. So I think once we get our facilitators trained in our approach, they're actually somewhat relieved because they have so many different directions that they can take the girls. And they realize that they don't have to have all the answers. What they have to have is the ability to foster that inquiry in the girls, in addition to being resourceful and figuring out how are we going to get the supplies; or, how are we going to make the connections."*

A *National Aeronautics and Space Administration (NASA)* study found that youth workers who possess strong skills in youth development and literacy training can be effective instructors of inquiry science, regardless of their level of science content knowledge (Walker, Wahl, & Rivas). Staff development should emphasize engagement in STEM and its connection to youth development. Teaching after-school educators to use the inquiry process that is fundamental to science learning, and then connecting that instructional practice with existing skills and talents, will increase the potential base of people who can successfully convey STEM concepts in after-school programs.

Finally, because after-school programs combine the goals of STEM learning and youth development, staff development must focus on activities that are appropriate to promoting both learning goals. There are many ways in which these goals may overlap. After-school programs can foster student interest and engagement in science by:

- Providing youth with the time, space, and resources to support their participation in fairs and events about science, math, and technology.
- Offering more time and greater access to youth who may not be doing well in science during in-school hours due to limited time and opportunities to learn science.
- Presenting the time, flexibility, and opportunity to engage youth in hands-on, interactive types of science activities that classroom teachers may not have time to do: "During the day…there's no time to stop the teachable moments [but] in an after school you can say, 'let's find out. You don't have to know'… All you need to do is be able to help a child figure out a way to find help." The freedom to explore also helps to increase personal investment in science by students and instructors because if a "kid has a question about it, that kid is then invested in the question and trying to find out the answer."
- Serving as a bridge between families and school by offering youth a place to explore things that they are interested in (such as science) and then, it is hoped, have them connect their interests back to the classroom.

As one *Community* member recommends, "If you think of it in terms of youth development goals, science is really ideal for the after-school setting because…it's 'segue' science that is fun and engaging. It encourages youth to be more involved in science, to think about science careers, to get interested in answering questions."

Envisioning after-school STEM as a "segue" from the real-world to the classroom also requires that expertise be transferred from staff developers to after-school providers. Given the model that all youth have three needs—Engagement, Capacity, and Continuity—to succeed in STEM, a high-quality system of after-school STEM programming provides a network for ensuring all three (Jolly, Campbell, & Perlman, 2004). After-school activities *engage* the youth with fun and interesting experiences that also connect to the school day, reinforcing the learning that defines *capacity.* Youth development provides *continuity*, by connecting participants to career options, role models, and skills to apply knowledge beyond the classroom.

Approaches to Staff Development

Staff development for after-school STEM requires unique approaches to transfer key understandings effectively within severe time constraints.

Not all staff development goals need to be met during a designated block of time for training. *Community of Practice* members agreed that there were multiple approaches for staff development, including staff meetings, networking opportunities, newsletters, coaching, job shadowing, conferences, online networks, and both online and face-to-face training. In addition, "research about where and how people learn has to do with on-the-job and feedback from their manager," so staff development can also be embedded with integrated, on-the-job training.

Community members discussed preferred ways to organize staff development opportunities to invest staff in STEM learning. One of these preferred formats included one to two days of initial training, with additional coaching and support throughout the year. Due to constraints in the amount of development time that is available to after-school staff, the *Community* also discussed strategies for supporting staff that have limited time. Strategies included integrating STEM into existing trainings. For example, providers combine science content with literacy strategies because "science content is often a very good way to get students interested in reading, because so many students are interested really in the science topic; they're engaging." The *Community* identified three key approaches that promote STEM learning within the limitations of after-school staff development time: partnerships and coaching, materials-focused, and process-focused.

Partnerships and Coaching

Several CSAS members have combined the expertise of STEM educators and after-school providers through systems of partnership and coaching. Most STEM educators who support after-school programs are school-day teachers or museum educators who also have other responsibilities during the workday. Since their time is limited, and because they are often expensive for after-school programs, they are best used in tandem with youth workers.

An effective partnership between organizations allows after-school programs to serve more children, often at a lower cost per child. STEM expertise could come from a school, a museum, or other nonprofit and for-profit organizations. After-school programs must commit their staff to working with the STEM expert and not depend on that expert to lead activities directly. For example, instead of having a science teacher or museum educator work directly with 20 kids, a partnership allows that expert to support 10 youth workers who each work with 10 kids.

In addition to partnerships with STEM educators, some after-school providers may have the opportunity to connect their students with professional scientists and engineers. These professionals can serve as role models and provide context to students who want to learn more about STEM careers. However, as with STEM education partners, programs can best use STEM professionals by incorporating their participation into a larger after-school activity that applies youth development principles. Some organizations have created formal tools and processes for incorporating STEM professionals into after-school programs. *Project Exploration* in Chicago, IL, is one organization that offers staff development for scientists and engineers that supports them to communicate directly with youth. *Techbridge* in Oakland, CA, has formalized this type of training into a *Role Model Toolkit*. This product is available on the *Techbridge* website free-of-charge.

By integrating partners into ongoing programs, after-school providers help their staff build new knowledge and skills. These youth workers often represent the communities they serve and can serve as ambassadors of STEM education to those communities. Some youth workers are on track to become classroom teachers and will benefit from early experiences with STEM instruction. Others will continue in youth work and become experts themselves.

EXAMPLE: One instance of successful partnership and coaching is the *Science in Service* program at Stanford University. Undergraduate science students (who are likely to have some content knowledge, but little understanding of STEM education pedagogy) are coached by expert STEM educators. These undergraduates then lead after-school activities at a nearby *Boys and Girls Club*. Over time, the staff at the *Boys and Girls Club* has also joined the university students in leading the activities.

Materials-Focused Staff Development

Staff development is often provided as a service, in conjunction with specific curricular materials. As discussed often at conferences and learned through surveys, after-school leaders frequently demand hands-on STEM activities that they can use immediately in their programs. Materials-focused staff development seeks to meet this demand while also providing instruction on STEM process (e.g., inquiry) and relevant pedagogy. Because this type of staff development supports implementation of materials that can be used at once, these staff development efforts are often easier to market to after-school programs.

There are concerns about any staff development that is directly tied to curriculum. Successful development depends on the curriculum developers having an understanding both of the content of the materials (STEM content and processes) and of the after-school environment. Those few materials developers who have this understanding must also commit to either providing the staff development or finding a partner to do so. Curriculum developers may prefer to move on to the next product and not commit to the ongoing requirements of providing staff development.

Materials-focused staff development may also discourage after-school providers from using other good materials. Many curriculum developers have responded to this concern by recommending extension activities and further resources. In these cases, staff development must prepare the providers to use these additional resources and to incorporate them into the larger program.

EXAMPLE: The *New Jersey Department of Education (NJDOE)*, the *Liberty Science Center*, and the *New Jersey School-Age Care Coalition* developed the *21st Century Afterschool Science Project* (*21st CASP*), a program model with curricula to help after-school providers integrate science into their existing programs. The curricula are freely available on the *NJDOE* website. The project team provides training and

technical assistance to after-school staff for integrating science into after-school settings, as well as on use of the *21st CASP* hands-on science curriculum.

The *21st CASP* seeks to enrich student learning and engagement through inquiry-based, informal experiences in science education. The project combined direct-service and macro-level approaches to ensure that the unique challenges encountered by today's after-school programs are addressed by producing a model for science enrichment. The project emphasizes connections between the essential components of scientific inquiry and the skills of language and mathematical literacy. The focus is on reaching children in grades 4–8 through after-school staff—including professional educators, youth workers, and paraprofessionals.

Process-Focused Staff Development

Staff development that is process focused helps after-school providers increase their skills as STEM instructors by supporting staff to engage in science learning activities with youth, regardless of what instructional materials they work with. While curriculum may be used to introduce a set of activities that could be replicated, it also provides a vehicle for modeling effective approaches to STEM instruction. Strategies focus on process, especially hands-on science inquiry.

The key difference between process- and materials-focus staff development is not a lack of specific science content but rather the absence of a single, specific curriculum. Those who provide process-focused staff development recognize that understanding science-process skills requires the practice of those skills around specific scientific content or ideas. It is not a process-only argument, but instead what the instructor chooses to emphasize in this context, that defines it as being process-focused.

Process-focused staff development is particularly difficult for novice instructors who want activities that they can do immediately. However, if successful, this type of professional development may provide widely applicable skills. Given the alignment between the inquiry process and youth development, as well as the focus on good instructional practices (such as reflection on what works and what does not), process-focused staff development may provide the best alignment for those seeking to support staff in a career ladder.

EXAMPLE: Staff developers, as in a pilot effort led by the *Exploratorium* in San Francisco, use the freedom from specific curriculum to explore multiple activities to teach a variety of instructional methods:

> *"In general, the first part of the workshop was organized around a science topic (e.g., sound) and introduced a number of activities related to this topic. A general pedagogical technique (e.g., observation, questioning in science) was embedded in the activity. In the second part of the workshop, participants were introduced to a few activities that focused on the pedagogy*

that was embedded in the activities during [the] first part of the workshop. To reinforce these pedagogical concepts, they were then introduced to a set of activities on another topic." (Barber, et al., 2006)

Inadequate Approaches

Missing from this list are one-time staff development opportunities that are not tied to additional resources or learning opportunities. It is possible to engage after-school providers with a set of fun activities that can be used immediately. However, follow-up is critical to ensure high-quality implementation. It is particularly important to note that limited follow-up can be an unintended consequence of underfunded or underdeveloped partnerships. For example, if after-school providers are taught an entire unit about water but only repeat one basic sink-and-float activity with their students, the staff development was incomplete.

Staff Development Providers

After-school STEM staff development is often taught by STEM education experts. Many of these experts are now developing an understanding of after-school and youth development goals as well.

Because after-school STEM combines two fields, there are two knowledge bases that are required for effective instruction: STEM learning and youth development. A STEM learning expert is grounded in knowledge of science content and process and has an array of pedagogical expertise that enables him or her to guide students through inquiry-based learning. A youth development expert has significant understanding of cognitive, social, and emotional development, along with pedagogical expertise, that enables him or her to support students in their development. While there is significant overlap between the processes used in these fields, only a small number of individuals have actually worked in both fields. These individuals—who can be found at organizations like the *Educational Equity Center* at *AED*—have taken the first steps in providing after-school STEM staff development. To reach a larger scale, it is necessary to combine expertise from STEM and youth development experts, using partnerships and collaboration in the delivery of staff development.

One of the most common strategies for providing staff development is to connect an expert in STEM learning with a targeted group of after-school providers. This strategy allows after-school providers to receive guidance based on the best practices in STEM learning. A STEM learning expert is also likely to have a strong understanding of STEM content and will ensure that the instructors are not promoting misconceptions. Teaching inquiry methods is one of the most difficult practices in education, and ensuring quality requires continued effort even for seasoned classroom veterans. Supporting after-school providers with STEM learning experts is the best way to ensure the quality of after-school instruction.

Drawbacks must be noted in relying upon STEM learning experts. There are a limited number of these experts, and their time is often expensive. These experts have traditionally focused on staff development for formal education, so their understanding of after-school and youth development priorities may not be as strong as that of someone fully versed in those fields.

Examples of *CSAS* member programs that rely on STEM experts as regular trainers include:

- Through the *National Partnership for After-School Science (NPASS)* project, science museum and *4-H*–affiliated professional trainers from across the country offer monthly training sessions and regular follow-up support to a committed cadre of community-based organizations in their regions, preparing them to facilitate open-ended and guided explorations of science and engineering topics with children. This project supports after-school providers with ongoing training opportunities. It also addresses the high turnover in after-school staff by relying on STEM experts (from museums and *4-H*) to provide continuity across the project.
- When the *Lawrence Hall of Science (LHS)* was asked by the *California Department of Education* to provide staff development to employees in the state-funded *After-School Education and Safety Program*, LHS turned to established experts from its existing formal education programs. To make sure that these experts, who specialize in staff development connected to the *GEMS* and *EQUALS* programs, were prepared to work with the unique after-school audience, *LHS* provided professional development and partnered with after-school practitioners to learn more about the after-school setting and its unique demands.

Strategies for Delivering Large-Scale Staff Development

Several national youth-serving organizations have long embraced STEM programming and now lead efforts to extend high-quality STEM learning opportunities to larger numbers of youth. Many CSAS members are seeking to replicate the success of the youth-serving organizations within other systems that support after-school learning.

Youth-Serving Organization Internal Programming

National youth-serving organizations, such as *4-H*, *Girls Incorporated*, and *Girl Scouts*, provide a coordinated system of support to staff who reach millions of youth. Since its inception, *4-H* has engaged youth in new developments, starting with agriculture, but now including rockets, robots, and more. *Girls Incorporated's Operation SMART* programs have offered girls a chance to experience science, math, and relevant technology for over 20 years. *Girl Scouts of the USA* has blazed a trail by partnering with *NASA* and other leading STEM organizations. Each organization is unique, though all benefit from national infrastructure and branding. Taken together, these organizations can reach a significant portion of the youth

population, and their successes offer lessons to smaller, regional providers of after-school STEM.

The majority of STEM programs at the national youth-serving organizations are supported by a combination of external STEM education experts and an internal capacity that combines both STEM and youth development. As these programs have grown, the organizations have increased the capacity of their own staff to provide staff development related to STEM. Because the organizations are large, they are able to maintain that staff development capacity over time.

EXAMPLES:
NASA experts have taught 31 *Girl Scouts* volunteers to deliver content and activities in five key areas of *NASA* (human exploration, robotics, global exploration, earth exploration, and global warming climate change). These trained volunteers, in turn, share their expertise by training additional volunteers. Over time, this expertise has become part of the *Girl Scouts* system, and *Girl Scouts* volunteers have become a target audience for *NASA* educators. The 31 volunteer staff development providers receive coaching through the partnership, but many more receive materials and process-based training that is directly relevant to their programmatic goals. This leads to thousands of girls experiencing STEM learning activities that were originally developed by small *NASA* teams.

Girls Inc.'s Operation SMART is the most popular and widely implemented *Girls Inc.* program. Since the mid-1980s, the program has reached over 500,000 girls across the country, boosting their interest in studying science and math, as well as opening their eyes to the existence and importance of these subjects in all aspects of their lives. The program depends on after-school professionals and volunteers as the primary activity leaders, but also incorporates STEM professionals as role models and content experts. Publications and staff training help after-school programs empower girls to pursue careers in science, math, and technology. Training is primarily delivered by *Girls Inc.* staff and is tied to the program guides. These publications support the process of STEM learning, offer specific activities, and refer providers to additional STEM activity guides.

The staff development strategy for the *4-H Science, Engineering, and Technology (SET)* Initiative is still under development, but it is being designed with all of the approaches in mind. Because *4-H* is based in the Land Grant University system, its leaders have unique access to STEM experts. By connecting these experts with the *4-H* philosophy of positive youth development, the system should expand connections between the after-school and STEM fields.

After-School Systems
The number of after-school programs has grown rapidly since the establishment in 1998 of a dedicated federal funding stream, called *21st Century Community*

Learning Centers (CCLC). Concurrently, the systems of support for these programs have expanded. Some of the state agencies that support *21st CCLC* programs have specifically targeted STEM as a tool for improving program quality.

In many urban areas, intermediaries provide a support network that includes staff development, and STEM is one area of focus for some of these organizations. Advocacy networks and professional organizations also provide staff development directly or support venues for offering staff development. Because each state and local region has a different set of after-school support systems, efforts to increase STEM staff development opportunities depend upon marketing and partnership-building. Despite these obstacles, efforts to connect though these systems have delivered success. Intermediaries and state agencies alike are able to influence large groups of after-school providers, especially at the leadership level.

Staff development providers have found success by involving after-school program leaders alongside frontline staff. There is general agreement about the effective nature of having the teams that participate in staff development include program leaders as well as staff from sites or programs. This helps to inform program leaders of what staff members need to be successful; encourages team members to go back to sites and support each other; and promotes longer-term sustainability of STEM in after-school programs since frontline staff may turn over.

> *"I think that you do have to have the interest and the buy-in from all levels because certainly the frontline staff is actually delivering the instruction or activity. But without the support of their superiors the whole thing kind of falls flat if you don't have that buy-in and support all the way up the line."*

System leaders, like state agencies and intermediaries, are needed to make STEM part of the standard after-school program. Providers of STEM staff development need to engage the entire system, not just the frontline staff. Furthermore, single trainings that are not tied to a larger program effort or connected to a wider system of staff development are not effective and may even undermine the case that STEM is a valuable component of any high-quality after-school program.

EXAMPLES:

The After-School Corporation (TASC), an intermediary in New York City that has helped launch over 300 sites, has identified STEM learning as being a critical component in its continuous efforts to improve after-school program quality. Through *Frontiers in Urban Science Education (FUSE)*, supported by the *Noyce Foundation*, *TASC* supports development of after-school STEM capacity at all levels of the after-school system. The program starts with internal STEM capacity at *TASC*, including a science program manager, two program staff, and commitments from other staff as well. *TASC* then provides staff development, first to key decision makers and then to frontline staff. This staff development combines *TASC's* understanding of the after-school community with resources and knowledge from

external STEM experts. *TASC's* commitment to STEM learning has helped create an expectation that STEM should be part of high-quality after-school in New York and beyond.

Great Science for Girls: Extension Services for Gender Equity in Science through After-School Programs (GSG) is providing after-school STEM expertise in order to build the capacity of intermediaries like *TASC*. *GSG* begins with process-based staff development, focused on broadening and sustaining girls' interest and persistence in STEM. *GSG* staff members then connect the intermediaries with materials-based staff development opportunities, providing after-school instructors with specific curricula that match the context of equity through STEM. To reach a large national audience, *GSG* is working with 16 regional intermediary organizations—four in the Northeast, four in the Midwest, four in the Southwest and West, and four in the South—that provide services to networks of after-school centers.

Recommendations

The information and analysis presented above suggests a number of recommendations, at several levels. First, CSAS offers several recommendations regarding staff development decisions that are made at the program level. Next, we examine recommendations for pursuing promising directions already under way in the field. Finally, we consider some forward-thinking initiatives that could extend high-quality staff development to this expanding field.

Program-Level Decisions About Staff Development

For many after-school sites, the decision to incorporate STEM into staff development will be made by a program director or site coordinator. Table 1 and the more extensive descriptions that follow it offer a spectrum of strategies for pursuing staff development.

Some of these strategies (A and B) are more suitable for "early engagers" who wish to include STEM in their programs. CSAS posits that while these strategies may offer good starting points for such efforts, they most likely will not result in consistent and sustained high-quality opportunities for youth on their own. The next set of strategies (C, D, and E) offer options for programs interested in and willing to commit to incorporating good science into existing programs. The final three options listed (F, G, and H) represent strategies that may result in embedding consistent and sustained high-quality science learning opportunities in committed programs.

CSAS recommends that providers of after-school programs consider these options and determine which best fits their circumstances:

Table 1: Staff Development Strategy Summary

Which staff development strategy is right for my organization?			
Strategy	**Who uses this strategy?**	**How does the strategy work?**	**What resources could make this strategy more effective?**
A. External STEM program provider	Programs that are not ready to use their existing staff to teach STEM or want to see how students react before investing in staff development.	An outside provider (such as a school-day teacher or external contractor) provides STEM activities directly to students.	After-school staff should be paired with the STEM provider to learn how to teach STEM, build general teaching skills, and eventually take over some of the STEM leadership.
B. Internal staff development	Programs that do not want to commit significant resources to staff development for STEM or cannot find a partner to help with staff development.	Program leaders provide staff development to existing after-school staff based upon commonly available materials (free Web resources, library books and school texts, curriculum guides).	• National Partnership for After-school Science free online guide • Curricula specifically designed for after-school • Foundations, Inc./EDC resource under development
C. Materials-based staff development	Programs willing to commit to a single set of materials and to the requirements of the materials-provider.	Many curriculum providers offer staff development in connection with their materials. This may be free, available for a fee, or built into the cost of the materials.	Use materials specifically designed for after-school, such as those listed in the *Consumers Guide*.
D. Partnerships with STEM providers	Programs that are open to partnership with museums, universities, and the like, and that are willing to embrace a mutual set of goals and objectives.	Most STEM providers will have a standard program that they can share—similar to materials-based staff development described above. Through partnership, this program should become customized to meet the needs of both organizations.	Ensure that the partnership meets the goals of both institutions. In addition to sharing their knowledge, STEM providers should develop an understanding of after-school and youth development goals.
E. STEM educators as coaches	Programs that have a STEM educator available and are willing to use that individual's skills as a coach of multiple other staff members.	A STEM educator (often a school-day teacher working in the after-school program) coaches other program staff members who, in turn, work directly with the youth.	Ensure that coaching is consistent with the goals of the after-school program (not just the school-day or state science standards). Resources listed above for Internal Staff Development will also support coaching.
F. Shared staffing with STEM institutions or STEM career ladder programs	Programs that have built robust partnerships with STEM institutions or are seeking to expand their partnerships.	A full-time job is created by combining part-time work at the STEM institution with work at the after-school program. Shared staffing could be part of a career ladder program leading to careers in informal or formal science education.	Several museums have created similar programs, but more resources are needed to increase the viability of shared staffing models.
G. STEM as a core program component	Programs seeking to define themselves as a place to explore STEM concepts or use STEM as a marketing tool.	A sufficient number of staff members receive development opportunities in order to serve all students throughout their time in the program.	Providers can follow the example of some national youth organizations that have created a unique set of engaging STEM programs: • Girls Incorporated's Operation SMART program trains adults

			nationwide in this program that can be used over multiple years. • Girl Scouts of the USA provides training to its network of staff and volunteers to offer multiple STEM options.
H. STEM integrated into youth development throughout the program	Programs seeking to define themselves as a place to explore STEM concepts or use STEM as a marketing tool.	All staff members receive development in STEM across disciplines. They learn to incorporate STEM into sports, arts, and other common activities. Summer and vacation programs have STEM themes that tie all activities together.	By incorporating STEM with youth development, 4-H continues to offer a high-quality youth program and meet the changing needs of a STEM-based society. 4-H resources are available through county extension offices nationwide.

A. Use External STEM Program Providers to Engage Internal Staff in STEM

If you currently offer STEM through an outside provider—such as a contractor that offers special activities on a weekly basis, or a classroom teacher who offers a science club to a select group of kids—your staff of youth workers can learn from their methods. As with the *Science in Service* program (p. 13), your staff can work in partnership with these external providers and learn strategies for incorporating STEM into other activities. Remember that your staff members are the ones who best know your kids. The youth in your programs are much more likely to engage in STEM learning if they see that it is not just a "special event."

B. Provide Staff Development Internally

Many organizations can only commit to staff development led by an internal staff member and limited to a short time period. Several resources have been developed in support of internal staff development, including:

- The *National Partnership for After-school Science* has developed a guide to preparing after-school staff to teach science. This guide includes a series of activities that will help you lead staff development on scientific inquiry methods. http://cse.edc.org/products/npassprofdevguide/
- With support from the *Noyce Foundation*, *Foundations, Inc.,* and the *Education Development Center* are partnering to develop a STEM training that can be replicated locally.
- Many curricula and program resources, such as A*fter-school Science PLUS* and *Operation SMART*, come with guides to preparing staff and implementing the program.

To provide youth with a positive STEM experience, after-school programs need to offer consistent, goal-focused programming. Goals that connect youth development and STEM objectives include either engagement—changing student attitudes about the role of STEM in their lives—or career pathways, thereby helping students recognize how they could use STEM in their future. High-quality staff development demonstrates to group leaders that they should not be the center of STEM activities; that activity objectives are primarily about STEM processes, not specific facts; and

that student attitudes toward STEM influence their future STEM engagement more than their school-day performance does. For these reasons, internal staff development should focus less on specific activities and more on the inquiry process, science conversations, and similar concepts that are student-centered and that best use the after-school setting as a time for youth to explore their own ideas.

While internal staff development is the most likely starting place for many programs, providing staff development that creates an appropriate expectation of student-centered STEM programming is not simple, because many staff are likely to have a "teaching is telling" approach to science that is difficult to reverse. For a comparable level of effort, most after-school sites could consider the trade-off of this investment and instead build a partnership with a local museum, *4-H* office, university, or other organization with STEM expertise.

C. Obtain Staff Development in Connection with Specific Materials

Many curriculum providers offer staff development in connection with their materials. This is a good option if your after-school program is willing and able to commit to a single set of materials, as high-quality materials often provide flexibility to supplement the materials with local resources. Materials-based staff development may be free, available for a fee, or built into the cost of the materials. Curriculum developers may be looking for partners to help evaluate the materials, so you can defer some costs by participating and providing feedback. See the description of *New Jersey's 21st Century After-School Science* Project (p. 13) for an example. Visit the *Consumer's Guide to Afterschool Science Resources* for reviews of materials that may connect to high-quality staff development opportunities: http://www.sedl.org/afterschool/guide/science/index.html.

D. Build a Partnership with a STEM Provider

By building a partnership with a local museum, university, or other STEM provider, you can obtain expert advice while building the capacity of your existing after-school staff. Unlike a contractual agreement, where one organization provides a service to the other, an effective partnership serves the goals of both partners. Partnerships require an investment of time and resources, but they also offer greater rewards than a simple contract does. Ensure that the partnership meets the goals of both institutions. In addition to sharing their knowledge with you, your STEM partners should develop an understanding of your after-school and youth development goals.

One example of a strong partnership occurred during the creation and testing of the After-School Math PLUS curriculum (developed by the Educational Equity Center at AED). The New York Hall of Science (NYHS) (a science museum) worked in partnership with the Chinese-American Planning Council (CPC) (a community-based after-school provider). CPC staff led the activities when the students were at the after-school site, and NYHS staff led activities when the students visited the museum, which they did on a regular basis. The staff of both institutions jointly

planned their activities to complement each other and shared understandings about what worked throughout the program. Neither organization was "providing training" to the other – instead, staff of each organization learned from the others on the project team.

E. Use STEM Educators as Coaches

Many after-school programs have a school-day teacher who provides science activities. To expand on this model of programming, you may wish to invite that science teacher to coach other after-school instructors to provide STEM programming. As a coach, the teacher can multiply his or her impact on the students. For example:

- In large programs where a science teacher was reaching only a portion of the students, after-school staff can offer STEM programs for all.
- After-school staff can supplement a weekly science club (led by the teacher) by offering student-centered activity sessions two or more times a week.
- The science teacher and after-school staff can work together to manage large groups of students engaged in STEM activities.

After-school providers commonly see employing a STEM educator as an alternative to building staff capacity. The opportunity to hire an expert STEM educator should instead be viewed as an opportunity. That educator should support the other after-school staff members to integrate STEM processes and thinking skills into all activities. The STEM educator may employ many of the practices described in Strategy B, Provide Staff Development Internally. S/he further extends that staff development by becoming a regular part of the STEM learning team in the after-school program.

F. Shared Staffing with STEM Institutions or STEM Career Ladder Programs

If you already have a partnership with a STEM provider and are looking to deepen and expand upon that partnership, you may consider a shared staffing arrangement. Most museums have high traffic during the school day and employ staff members who provide programs to students on field trips. Combining this work with your staffing requirements could create a full-time work opportunity.

Creating a shared position could involve hiring new staff or expanding existing staff responsibilities. Because shared staff members must serve the goals of two institutions, you and your partner should be willing to compromise on requirements. Some efforts to hire shared staff have failed because qualified employees could not be found, so be prepared to search for good candidates who can grow into the position.

Shared staffing may also be part of a career ladder program leading to careers in informal or formal science education. Many after-school staff members are on a

path to careers in teaching. By providing STEM staff development opportunities, you are expanding the future career options of your staff.

G. STEM as a Core Program Component

By creating a unique set of engaging STEM programs, some youth providers create wide demand for their programs. For example:

- *Girls Incorporated*'s Operation SMART program trains adults nationwide in this program, which can be used over multiple years.
- *Girl Scouts of the USA* provides training to its network of staff and volunteers to offer multiple STEM options, such as robotics and *NASA* space science.

Leaders from these programs report that youth seek out the STEM opportunities that they offer. By integrating youth development into the STEM program options, these programs have incorporated STEM without sacrificing youth development goals.

H. STEM Integrated into Youth Development Throughout the Program

Programs seeking to define themselves as a place to explore STEM concepts or use STEM as a marketing tool may consider integrating STEM into *all* activities. This requires intensive staff development, thereby providing staff with sufficient skills to include STEM processes in sports, art, and other after-school activities. The *4-H Science, Engineering, and Technology (SET)* initiative is attempting to integrate *SET* into a large portion *of 4-H* programs. By incorporating STEM with youth development, 4-H continues to offer a high-quality youth program while meeting the changing needs of a STEM-based society.

Pursuing Promising Directions in the Field

As evidenced above, extensive efforts are already in place to provide staff development through various initiatives. However, many of these efforts are focused on promoting specific initiatives. To move the field forward, it will be critical for STEM and after-school leaders, policymakers, and funders to continue to work together to create a system that supports and expands existing staff development structures and related field-building efforts. *CSAS* recommends that supporters of after-school STEM invest in ways to transform the existing cadre of after-school instructors into effective facilitators of STEM learning. Investments in staff development should focus on one or more of the following:

Build STEM into existing efforts to professionalize after-school leadership.

Many organizations, especially those that belong to the *Next Generation Youth Work Coalition*, are developing career-building opportunities for managers and frontline staff in the after-school field. STEM staff development activities must align with the existing set of goals in the larger field. Additionally, the youth work field should recognize that STEM learning—especially processes such as inquiry—is well aligned to youth development goals and objectives. Well-designed STEM staff-development opportunities will meet the objectives of both fields, leading to high-quality programs led by a sustainable workforce.

Build and expand partnerships between STEM experts and after-school program providers.
These partnerships should focus on tailoring STEM staff-development practices to the needs of youth workers. This practice is already in place in many circumstances (such as *NASA's* partnership with *Girl Scouts*). The creation of true partnerships—those that use the resources and expertise of both organizations—is critical, and merely inviting youth development or after-school experts to consult or advise is not a sufficient substitute.

Build on and expand opportunities for sharing of "what works."
The members of the *Community of Practice* represent the leading providers of after-school STEM staff development. Yet, even among these organizations there has been limited sharing of best practices and resources. Most sharing happens through informal interactions, such as individual conversations, and efforts to document best practices are challenged by a lack of compelling empirical data to support the practical wisdom from the field or even an institutionalized mechanism for discussion and debate.

Build and expand a common staff-development infrastructure that supports consistency among efforts.
Several examples of existing and emerging staff-development infrastructure have been highlighted above. Promising directions for this field include: (1) using existing infrastructures—of large-scale youth serving organizational infrastructures and Science-Rich Educational Institutions (informal science institutions, universities, laboratories, etc.)—and (2) developing new infrastructures (e.g., Web-based professional development). Both these strategies offer exciting scale-up possibilities.

Extending High-Quality Staff Development to an Expanding Field

CSAS challenges the field to vigorously pursue these promising directions, with the goal of preparing and supporting after-school staff to deliver high-quality STEM experiences to the largest possible number of students. In addition, CSAS recommends extending beyond existing efforts and engaging in transformative initiatives that expand the field further. The initiative examples described below are intended to bring this recommendation to life.

Use Cooperative Staffing Arrangements
Develop full-time employment opportunities through cooperative staffing arrangements.

Two examples of cooperative staffing arrangements have been suggested:

- *Schools and after-school providers* can cooperate to create full-time employment opportunities for educators. Individuals could work in the public

school system as aides or paraprofessionals in support of science education and youth development and for after-school providers as STEM instructors.

- *Informal science institutions and community-based organizations* can cooperate to create full-time career opportunities for science educators. Many museums already maintain a staff working in a dual role, either working on the museum floor or providing outreach events to schools during the morning and working on-site with children in after-school programs in the afternoon. Through cooperative hiring, informal science institutions could share staff with a community-based after-school provider.

In both cases, each institution would provide appropriate staff development—in STEM education and youth development practices—thereby giving the staff members capacity to bridge the two fields. These staff members could be hired through *AmeriCorps* or similar funding sources and should be offered opportunities to follow a career ladder toward classroom teaching or program leadership.

This is an innovative way to fund staff, develop skills from both fields, and establish connections across organizations. The cooperative hiring process would be transformative for many organizations. That process would build a substantive connection between organizations from the beginning of the partnership. A cooperative staffing approach would also be adding people who can help transform the field from the inside.

Professionalize the Field

Professionalizing the after-school field has the potential to transform the types of learning experiences available to youth in after-school programs and the field as a whole. Incorporating STEM into these efforts adds a further emphasis on STEM as a part of youth development.

Inclusion of STEM in existing efforts to expand the professional after-school field makes it possible for after-school STEM to happen through the existing and expanding workforce. STEM is likely to appeal to this workforce when approached within a larger framework of youth development, as well as by connecting to the interest that many after-school providers have in using youth work as a stepping-stone to classroom teaching. Several options could support professionalization of this field: (1) create an after-school credential program or certificate program that integrates STEM in colleges and universities, (2) train full-time staff to work as teaching assistants during school hours and as instructors during after-school hours, or (3) develop a pipeline and career pathway for STEM teachers that includes service as an after-school instructor in college and leads to entry into a teacher credentialing program.

Identify Materials that Support Staff Development
Given the limited time available for after-school staff development, curricula that also support staff learning would increase the impact of after-school STEM programs.

Some curricula in the formal education field have been shown to be effective tools, not just for teaching students but also for improving teacher understanding. There have been no specific efforts to identify which types of after-school curricular materials are best at assisting after-school instructors to learn STEM while teaching. Further, effective staff development is often connected to effective materials, but it is difficult to discern if one or the other (or the combination of both) is the source of the benefit. Furthermore, after-school staff members often seek materials first and quality second—high-quality materials can be the impetus for developing staff interest and expertise in after-school STEM over time. Gaining a greater understanding of how instructors learn, as well as what works for whom and under what conditions, could transform the approach of both staff development and curriculum providers. Studies could identify existing materials and identify characteristics that could be replicated in new materials. Efforts such as these would embody at least two of the recommendations above.

Develop a Cadre of Expert Staff Development Providers
A nationally available cadre of experts is needed to provide high-quality staff development opportunities and support the inclusion of STEM within the larger after-school context.

The field needs providers who understand high-quality staff development in STEM as well as youth development. Only a small number of people currently possess both sets of skills. Experts in both skill sets need support to cross over. Existing staff development providers in STEM and youth development need to expand their expertise to include the other discipline. These providers should find support both among national youth-serving organizations that have embraced STEM programming and among regional intermediaries that are working to replicate best practices among local after-school programs. Creation of a cadre of expert staff-development providers, who connect to each other by sharing experiences and best practices, will make high-quality after-school STEM happen by supporting the process of integrating STEM and youth development.

Conclusion

Staff expertise is critical to supporting quality science-learning opportunities for youth in out-of-school settings. Moving the after-school STEM field forward will require that STEM and after-school leaders, policymakers, and funders alike continue to work together to create a system that supports, expands, and invents staff development structures and related field-building efforts. *CSAS* encourages continued support for promising existing and new directions that prepare and support after-school staff to deliver high-quality STEM experiences to youth.

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Appendix A

Members of the Community of Practice (Staff Development)

- *The After-School Corporation:* Maryann Stimmer
- *California Department of Education:* Yvonne Evans, Patricia Terry
- *Education Development Center:* Charlie Hutchison
- *Educational Equity Center at AED:* Merle Froschl
- *Exploratorium:* Vivian Altmann
- *Girl Scouts of the USA:* Michelle Hailey
- *Girls Incorporated:* Penn Sheppard
- *Lawrence Hall of Science:* Traci Weirman, Karen Mayfield-Ingram
- *NASA:* Leslie Lowes
- *National 4-H Council:* Pam Garza
- *Schools Out Washington:* Krista Galloway, Zach Wilson
- *SEDL:* Marilyn Heath

Appendix B

CSAS Staff Development Community of Practice
Key Concepts from Teleconferences

This document combines recent research on staff capacity and development for STEM in after-school settings with feedback from leading practitioners across the country who participated in a series of three conference calls to foster a community of practice, with a focus on staff development. The paper first summarizes the background information shared with the members of the community as fodder for their discussion and then summarizes some of the concepts and issues discussed during the calls.

Background: What do we know from research about after-school staff needs and staff development opportunities?
According to recent research, the after-school workforce is highly diverse, with a wide variety of ages, education levels, and life and work experiences. Job satisfaction is high but so is turnover, and a significant percentage of youth workers (60%) would like full-time employment, additional training, and support. Those interested in expanding opportunities for inquiry science in after-school settings can draw upon recent studies suggesting that youth workers who have strong skills in youth development and literacy training can be effective instructors of inquiry science, regardless of their level of knowledge of actual science content. In addition, other resources such as toolkits, curricula, and best practices have been developed to help support the inclusion of inquiry science in after-school programs. As shared by leading practitioners in the area of professional development for STEM in after-school settings, there are other issues and opportunities that are available to help expand the inclusion of inquiry science in after-school.

What do we know from the field?
Based on feedback from the conference calls, extensive efforts are under way to provide staff development through various initiatives such as *NASA*, *Greater Science for Girls*, and *Project SMART*, among others. However, these efforts are focused on promoting specific initiatives, and an overall system of staff development for science in after-school is limited, though efforts are being made through organizations such as the *Next Generation Youth Work Coalition* to bring together stakeholders focused on improving the after-school youth workforce.

As suggested by participants, attending to staff development needs of after-school leaders would address several important goals, including the expansion of opportunities for high-quality, inquiry-based science in after-school settings as well as the potential expansion of the pipeline of women and minority candidates who want to pursue STEM careers.

Current Topics and Issues:

(1) What constitutes effective professional development for after-school programs?

The goals for professional development include increasing staff knowledge, skill, attitudes, and behaviors around various topics, including science. Participants on the call agreed that there were multiple approaches for staff development, such as staff meetings, networking opportunities, newsletters, coaching, job shadowing, conferences, online networks, and both online and face-to-face training. In addition, "research about where and how people learn has to do with on the job [training] and feedback from their manager" so professional development can also be embedded with on-the-job training that is not a separate event but ongoing.

Several examples of extensive training and professional development were provided, including the *Girl Scouts'* partnership with *NASA*. Thirty-one volunteers have been trained in five key areas of *NASA* (human exploration, robotics, global exploration, earth exploration, and global warming/climate change) to deliver content and activities as well as "train the trainers" of additional volunteers to present content and activities.

There was general agreement about the effective nature of having teams, including program leaders as well as frontline staff from sites or programs, participate in training and professional development. This helps to inform program leaders what frontline staff need to be successful; encourages team members to go back to sites and support each other; and promotes longer-tem sustainability of STEM in after-school programs, since frontline staff may turn over.

As summarized by one participant, "I think that you do have to have the interest and the buy-in from all levels because certainly the frontline staff is actually delivering the instruction or activity. But without the support of their superiors the whole thing kind of falls flat if you don't have that buy-in and support all the way up the line."

Also, there was general agreement that emphasis on science interest and expertise as well as youth development are both important skills and talents to foster through training and professional development that help to increase the potential base of people who can successfully convey inquiry science in after-school programs.

(2) What is the role of after-school programs in providing opportunities for science to youth?

As context for this discussion, a recent report from the *WT Grant Foundation* about the role of academics in after-school programs was referenced. For the purposes of this group's discussion, there is the additional question of the role of science as an academic subject in after-school programs.

Participants offered the following ways that after-school programs can foster student interest and engagement in science by:

- Providing youth with the time, space, and resources to support their participation in science, math, and technology fairs and events;
- Offering the time and access to youth who may not be doing well in science during in-school hours due to limited time and opportunities to learn science;
- Presenting the time, flexibility, and opportunity to engage youth in hands-on, interactive types of science activities that classroom teachers may not have time to do: "During the day…there's no time to stop the teachable moments [but] in an after school you can say, 'let's find out. You don't have to know'… All you need to do is be able to help a child figure out a way to find help." The freedom to explore also helps to increase personal investment in science by students and instructors because if a "kid has a question about it, that kid is then invested in the question and trying to find out the answer";
- Serving as a bridge between families and school by offering youth the place to explore things that they are interested in (such as science) and then hopefully have them connect their interests back to the classroom.

Issues that after-school programs are facing:

- Schools focus on helping students pass standardized tests that limit the amount of time spent on enrichment in after-school programs as they may serve students who are struggling to achieve.
- Some programs may have staff who understand how to "develop the creative curriculum and understand what sort of resources are available to them." But there was general agreement that after-school staff and supervisors often do not have the time or the expertise to plan for creative, enrichment activities that go beyond simply keeping students safe or providing tutoring.
- For some programs, there is outdated or limited technology on sites that constrains presentation or engagement of youth in creative technology based projects.
- Staff members in after-school programs have the "mind-set" that science is "part of the academics only and they're not looking at it as the enrichment." As a result, "the kids begin to only think of it as academics and they lose the enrichment part." This will take time to change.

It was generally agreed that while some after-school programs such as *21st Century* programs may have classroom teachers as after-school instructors, a large portion of after-school leaders and instructors are individuals who are interested in education and youth development but do not want to be part of the formal education system. Rather, they prefer the after-school environment that is a little bit less structured: "it's really a mind-set towards informal education and informal learning towards the kids." Given staff members' desire for more flexibility and less structure, participants offered suggestions as to what the content of staff development for after-school leaders should include.

Content of staff development for after-school should:

- Offer exposure to materials, supplies, equipment and curricular resources.
- Give individuals the materials they need to implement their science projects and activities because (1) they are so limited in their time to prepare activities that, often, "the first time they're looking at the materials is on the bus between school and afterschool" and (2) materials should be easily accessible because they going to be familiar for the youth and so they will feel more comfortable with "doing science" since the materials are so familiar.
- Include science content, which is important and can be effective as a hook, though trainings should focus more on process, methods, or an approach to teaching science. Since staff turnover in after-school programs is an issue, several practitioners reported that if a group of staff from the same program were trained on method, then the method or approach continues in the program even if the staff leave.
    1. The methods or approaches can focus on helping after-school leaders to ask good questions: "It's framing good questions. They'll ask questions about what a student knows…ask questions as to why this works, why doesn't it happen this way? Well, what happens if I did that—I tried that last time. The classroom teachers don't have time for that kind of discussion. And so the after school setting is particularly relevant for that and when you're doing staff development, that's what we try to do."
    2. Another approach that has been presented through staff development through *Operation SMART* is the promotion of positive attitudes towards Science, Math, Engineering, and Technology "to create interest, to create confidence, and to really lay that foundation for learning to question and learning to inspire. The girls don't have the pressure to get a grade in science or math. In an afterschool program, it's about learning at your pace; carrying out what you like; what you want to focus on; figuring out what are the real-life applications to what this experiment that we're doing or this activity that we're doing. So I think once we get our facilitators trained in our approach, they're actually somewhat relieved because they have so many different directions that they can take the girls. And they realize that they don't have to have all the answers. What they have to have is the ability to foster that inquiry in the girls in addition to being resourceful and figuring out how are we going to get the [needs] supplied; or how are we going to make the connections."

Participants also suggested effective ways to organize staff development opportunities to invest staff in science, including one to two days of initial training, with additional coaching and support throughout the school year. There are, however, serious constraints in the amount of training time that is available to after-school leaders and instructors. For example, there was agreement that there were high-quality materials available to support science in after-school settings but the

"dilemma" is that it was challenging to figure out how to get after-school staff to use them. As a result, there was also discussion about how to integrate science into existing trainings. Some suggestions that came from the group included:

- Integrating science content into literacy training strategies because "science content is often a very good way to get students interested in reading, because so many students are interested really in the science topic; they're engaging."

Role of science in after-school

- "If you think of it in terms of youth development goals, science is really ideal for the after-school setting because…it's 'segue' science that is fun and engaging. It encourages youth to be more involved in science, to think about science careers, to get interested in answering questions.

Issue: What about science can be taught in after-school?

- "So we're more about providing an environment where kids see themselves as scientists, where they're given lots of opportunities to explore the things that they're interested in so that they can see themselves as a scientist and they can see it…that they have the tools that they need to address any content area just based on their personal interest. But it's more about creating that interest in the kids in science; giving them a place to explore things that they're interested in rather than what the curriculum is—the structured curriculum is."
- Balance of process and content: "I think it's in the way that the content is addressed, not so much that the content shouldn't be a part of that. I think it has to do with the manner that the after school staff engages the student. I think that they can increase their understanding of concepts or at least help them clarify where their questions are."
- Help individual students interested in science: "they can do things like encourage and support students when they are trying to enter science fairs"; "you can be a resource or they can be a resource to help these students focus on specific projects and specific activities that they might like to prepare for or do."
- Help students who ordinarily might not be able to keep up in class/pace: "If you're talking about providing access for students who have not traditionally [done well] or [are] not currently doing well in mathematics, and or science, the after school setting can provide time for experience in the types of hands-on interactive kinds of activities that classroom teachers don't have a chance to do."