The Legacy of *YouthAlive!*

Transformative Youth Programs Continue to Thrive in Science Centers

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Abstract

YouthALIVE! (Youth Achievement through Learning, Involvement, Volunteering, and Employment) was an initiative in the 1990s of the Association of Science-Technology Centers with support from the DeWitt-Wallace Reader's Digest Fund to enable museums and science centers to establish programs for youth from underserved populations. *YouthALIVE!* programs are characterized by intensive, multi-year engagement in the life of the institution, including a wide variety of opportunities for science teaching, learning, and mentoring, and conducting scientific research. Evaluation studies show that youth involved in these programs have high rates of high school graduation, college enrollment and pursuit of STEM careers. During the 1990s, 72 institutions received funds to establish *YouthALIVE!* programs. Although institutional grants ceased more than ten years ago, the number of youth programs at museums and science centers has grown to 163, demonstrating that philanthropic initiatives that are thoughtfully planned in collaboration with museums and science centers, meet multiple needs, and are based on clear principles, can survive and thrive when major funding ends.

Introduction

For many museums and science centers, foundation support provides an essential means to experiment with new programs and to serve new audiences. However, success does not necessarily lead to longevity since most foundation trustees prefer to seed new initiatives rather than support ongoing efforts. And while it is sometimes possible to keep successful programs going for a time after the grant period ends, in most cases the program languishes along with the funding.

Nonetheless, every now and then an innovation will prove to be so successful that even when major funding is over, the program takes on new vigor and not only garners support at the home institution, but is also picked up by other organizations and takes on a life of its own. Such is the case of *YouthALIVE!,* an initiative of the Association of Science-Technology Centers (ASTC) with support of the DeWitt-Wallace Reader's Digest Fund (now part of the Wallace Foundation).

As initially conceived, and still practiced in many museums and science centers, including zoos and aquaria, *YouthALIVE!* served high school-age youth underrepresented in technical fields, primarily teens of color, youth from low income communities and girls. Contact usually begins

in a student's freshman or sophomore year (and sometimes as early as middle school) and continues through high school graduation. The youth involved in these programs both attend and teach afterschool and weekend science classes, work in summer camps, serve as exhibit interpreters on the museum floor, and in some cases help scientists conduct research. While specific programs are varied, the common factors are frequent contact, a club-like atmosphere, dedicated staff with youth development experience, and a focus on learning, teaching and developing a strong work ethic as well as a sense of community. Although few formal evaluations of these programs are available, those that have been conducted show very positive results with high school graduation, college enrollment, and percentages of students pursuing careers in the sciences at much higher rates than the general population.

Surprisingly, many of the people working in these programs are not aware of the beginnings of *YouthALIVE!* nor of how many such programs currently exist nationwide. In fact, discovery of the extent of these programs was somewhat accidental, the result of a landscape study in support of a strategic planning project for the California Academy of Sciences with support from the S. D. Bechtel Jr. Foundation.

To place the current study into context, this paper begins with a brief summary of prior studies that surveyed the educational contributions of museums and science centers. Part two is a history of *YouthALIVE!* with reference to evaluation reports. Part three describes the findings of the current study, which was conducted by analyzing websites of nearly 400 hundred museums and science centers. The paper concludes with the authors' perspectives on why this particular innovation has been so successful, and what it has to tell us about the vibrant lives of our nation's non-profit institutions and the importance of intentional and focused philanthropy.

Prior Landscape Studies

Several studies have been undertaken to document the role that museums and science centers play in supporting our nation's educational system. One of the first, undertaken by Inverness Research Associates, found that museums and science centers provide a vast and previously unknown source of support to our nation's schools. Entitled *An Invisible Infrastructure*, the study found that 75% of informal science institutions provide direct services to local schools, support such efforts with their own budgeted funds, and collectively provide professional development to 150,000 teachers a year (IRA 1996).

The Institute of Museum and Library Services (IMLS) conducted a study of 11,000 museums of various types and sizes. The study, entitled *True Needs, True Partners 2002*, found that museums offer a wide range of learning activities that include not only school visits but also pre- and post-visit services; resource kits and traveling exhibits, web-based experiences and curricula, and in-service teacher training. Cumulatively, museums spent over a billion dollars every year on K-12 programs. (IMLS 2002)

The Center for Informal Learning and Schools (CILS), based at the Exploratorium in San Francisco, analyzed surveys from about 500 informal science institutions and found results similar to the previous studies in terms of the number of teachers and students served and the range of services provided. The study also reported a strong desire by informal science educators to serve students from populations underrepresented in STEM fields, and noted concern about

the declining number of school visitors as a consequence of shrinking school budgets and neglect of science in favor of reading and math. (CILS 2006)

The Center for Advancement of Informal Science Education (CAISE) conducted case studies of deep and meaningful collaborations between schools and informal learning institutions, illustrating that such collaborations fall exactly within the core activities of both schools and informal learning organizations. However, in many cases successful collaborations failed to institutionalize when funding ended or there was a change in leadership. (Bevan et al 2010)

History of *YouthALIVE!*

YouthALIVE! was a response by a small group of individuals within the science center community to a series of reports in the late 1980s that made a compelling case for action—without developmentally appropriate intervention, the talent and potential of too many young people was being lost. A survey of ASTC member museums conducted at about that time found that although senior staff at some science centers recognized the importance of programs for adolescents, very few understood how to design programs to meet the needs of teenagers from underserved communities. (ASTC 2001)

YouthALIVE! was launched in 1991 with support from the DeWitt-Wallace Reader's Digest Fund to bring opportunities for education and personal growth to children of color and those from low-income communities. Funding and technical assistance were provided to science centers, natural history museums, technology centers, children's museums, aquariums, botanical gardens, and zoos to develop, implement, and sustain dynamic programs for young people, ages 10 to 17.

In contrast to one-day school visit programs, after-school classes, and summer camps that typically serve tens or hundreds of thousands of youth at a single institution during a year, *YouthALIVE!* programs were small, usually serving no more that 25-30 youth at any one institution. And since the same young people were encouraged to participate for several years (until high school graduation) the total numbers were relatively small. After ten years of ongoing funding, ASTC (2001) reported that a total of 7,000 youths were served through these programs.

Although there were significant differences from one institution to the next, there were also commonalities. All *YouthALIVE!* programs engaged high school aged youth, ages 14 through 17, and many also included middle school students, age 10-13. The younger children were usually involved in engaging hands-on workshops to increase their interest in science and overall science literacy, while the older youth received more in-depth science instruction and worked in such roles as explainers on the museum floor, teaching assistants in classes and camps, and in animal care. At some institutions youth were paid for their work, at others they served as volunteers. However, staff at all institutions agreed to base their programs on Principles of Best Practice (Table 1), which evolved over time as staff, participants, and program evaluators shared their experiences.

Table 1. *YouthALIVE!* Principles of Best Practice*

- Both the needs of the institution and the needs of youth are met through the program.
- The museum is committed to integrating participants into the fabric of the entire institution.
- The programs operate year-round and participants have at least 120 contact hours (hours of participation at the institution) per year.
- The rules and expectations for the participants in the program are appropriately flexible.
- Participants work in small groups with staff members and mentors who challenge the young people intellectually.
- The institution nurtures a positive peer culture, as participants from diverse backgrounds work together on common tasks.
- Participants are given responsibilities commensurate with their developmental needs.
- Participants engage in tasks that are of interest to them and enhance their perceptions of their own capabilities and futures.
- Participants are provided stimulating opportunities to make connections between their museum experiences, career possibilities, and educational paths.
- Program staff members recognize the importance of family support and seek to involve the families of targeted youth.

* Source: ASTC 2001.

Published evaluations of *YouthALIVE!* programs have strongly supported their value to the participants. An especially interesting series of studies focused on the Science Career Ladder (SCL) at the New York Hall of Science in Queens, New York, which was one of the first science centers to receive funding for a *YouthALIVE!* program. Gupta and Siegel (2007) described studies conducted in 1991, 1994, 2002, and 2005 which provided feedback to senior program staff that resulted in changes to key elements of the program, and also documented positive impacts on youth, such as increased self-confidence, improved skills in communicating, teaching, and working with diverse groups of people, increased knowledge and curiosity about science, enhanced personal growth, and higher rates of college attendance and career choices in STEM fields than in the general population. By 2007, more than 1,800 students had graduated from the Science Career Ladder Program.

The website of the Museum of Science & Industry (MOSI) in Tampa, Florida, also one of the original *YouthALIVE!* sites, reports the results of its Youth Exploring Science (YES!) program as follows: "90% of participants have furthered their education by attending college. 87% become mentors for current YES! Team members. 20% currently assist with designing science curriculum as a MOSI InterActor. And nearly 82% of YES! Team members pursue careers in math and science."

Evaluators at Lawrence Hall of Science at UC Berkeley conducted a ten-year retrospective study of Project Exploration (PE), a nonprofit organization in Chicago that recruits minority youth and girls to go on field expeditions with paleontologists and to work with visitors in the city's science museums. The researchers surveyed and/or interviewed 30% of the former PE participants who were aged 18 and over, and found that 95% of the respondents have graduated high school or are on track to graduate, nearly double the overall rate of Chicago Public Schools. In addition, 61% of students currently enrolled in a four-year college reported pursuing degrees in STEM-related fields; and 59% of four-year college graduates reported earning a degree in a STEM-related field. (Chi and Snow 2010)

In retrospect, the *YouthALIVE!* initiative may be seen as a decade-long experiment to determine what would happen if science centers and museums were to establish intensive multi-year programs for youth in their local communities. As judged by available evaluation results the experiment was a success in that the vast majority of participants in these programs graduated from high school at a much higher rate than their classmates, most of the participants went on to college, and many went into technical fields. However, like virtually all successful educational experiments, funding for *YouthALIVE!* eventually came to an end.

Method

The purpose of the present study was not initially to investigate the legacy of *YouthALIVE!*. However, as it became clear that so many institutions provided programs for youth in their local communities that embraced many or all of the *YouthALIVE!* Principles of Best Practice, our focus broadened from providing information to the California Academy of Sciences (the Academy) on best practices, to conducting a comprehensive study of youth programs to inform our colleagues from other museums and science centers.

Our method was to search websites of science centers and museums for information about multi-year youth programs. Our pilot effort included about 25 science centers, including several that had youth programs that we were already aware of. Our second effort was a search of about 200 museums and science centers. Our third and final search, conducted to prepare a publication for our colleagues in the field was a systematic search of 393 websites that included all member institutions of the Association of Science Technology Centers (ASTC) in the United States that classified themselves as either science centers or museums.

The search method was to click on a major heading, such as "Education," or "Programs," most likely to include references to youth programs. If that produced no obvious information, we would next search less likely headings such as "News," "Events," or "About Us." We also checked under "Volunteer" to see if there were special volunteer programs for youth. If we still did not find references to youth programs, we would browse the entire site using the search terms "youth" and "teen" and check each item. We copied all relevant information onto a master file for later detailed analysis, and finally summarized the data in Table 2 (at the end of this article), which lists institutions that have youth programs by type and features.

Findings

Numbers of Programs

The surprising result was that 163 museums and science centers— 41% of all museums and science centers in ASTC's U.S. database—have some sort of special program for youth, including many children's museums (not included in the first or second searches since we expected these institutions to focus just on younger children.) We should emphasize, however, that 41% is a lower bound, since not all science centers describe their youth programs on their websites. (Website listing is not needed for marketing since recruitment is generally done through local schools or community organizations.) We can say with confidence that *at least* 163 museums and science centers in the United States have intensive programs for youth or teens that extend over several years, that involve youth in both learning and teaching science, and that foster learning skills that will serve them well in academia and the world of work.

Of the 163 programs listed in Table 2, 160 of these programs are headquartered at museums or science centers; while two of the programs (Youth Astronomy Apprenticeship at MIT and Space Explorers at the University of Chicago) are headquartered at universities, and one (Project Exploration) is an independent non-profit organization. Each of these three organizations have close partnerships with informal science centers where the youth do work similar to the other 160 youth programs.

Regarding the number of original *YouthALIVE!* organizations that still have youth programs, of the 72 institutions that received program grants, 47 (65%) still have programs for youth—ten years after initial grant funding ended.

Like the earlier *YouthALIVE!* programs, most programs today remain small, with capacity for about 25-30 active participants at any one time. However, some have grown considerably larger. The St. Louis Science Center's Youth Exploring Science (YES!) program is the largest program at a single site, with 250 high school-age youth currently engaged in multi-year programs with diverse learning opportunities and a growing use of digital media. The program is supervised by approximately 30 paid staff, and led by a Vice President of the science center. Program leaders have plans to double the size of their program.

Even more youth at multiple sites are served by the Intel Computer Clubhouse Network that started as a *YouthALIVE!* program grant to The Computer Museum in Boston. When the Computer Museum merged with Boston's Museum of Science, it began exponential growth. With support of Intel, the Computer Clubhouse model expanded to 100 locations around the world, and currently serves 25,000 youth each year.

An even more remarkable finding is that 119 institutions that did not receive program grants under the *YouthALIVE!* initiative now have special programs for youth. Although it is not possible to determine for certain if these additional programs were inspired by the *Youth*ALIVE! movement, it is evident that at least 163 intensive youth programs exist today, where few existed twenty years ago. In summary:

- 47 (65%) *YouthALIVE! program grantees* still have youth programs today.
- 163 (41%) of *all museums and science centers* in the U.S. that are members of ASTC now have active youth programs.

Types of Youth Programs

Museums and science centers tend to identify intensive, long term programs for teens as one of three types: Youth Programs, Teen Volunteer Programs, or Internships.

Youth Programs are those that are identified as multi-year programs for "teens" or "youth" that involve students deeply in the life of the organization, based on principles much like *YouthALIVE!.* The typical age range for these programs is 14-18, occasionally with introductory programs for middle school youth ages 11-13. Shorter programs such as camps and classes are not considered "youth programs" for the purpose of this study.

Teen Volunteer Programs are usually listed on the organization's website along with volunteer opportunities for adults, but in a separate paragraph or page. One difference between youth programs and teen volunteer programs is that most (though not all) youth programs pay participants for teaching and providing support to staff, while teen volunteer programs do not pay. Programs in this category are distinct from adult volunteer programs, and typically describe what the teens will learn from the program and what they will be expected to do. A statement such as "Volunteers must be at least 14 years of age" does not qualify as a teen or youth volunteer program for the purpose of this study.

Internships are much like the other two types of programs, except they are identified by the organization with the term "internship" rather than "youth program." Some of these programs are paid internships, while others are volunteer programs.

For this study, institutions like the Museum of Science in Boston that have youth programs and volunteer programs specifically for youth were listed just once, under Youth Programs, to avoid double counting.

Features of Youth Programs

In order to determine patterns of similarities and differences among programs we examined the master file, which contains information drawn from the museum and science center websites, to formulate a short list of common features.

Learning: Opportunities to learn science.

Teaching: Opportunities to teach museum visitors, or children in camps, classes, or community outreach programs.

Life Skills: Opportunities to gain skills for success in school, work, and life.

Mentoring: Youth are assigned a mentor; and/or have opportunities to mentor younger children as they advance in the program.

Research: Opportunities to assist scientists in conducting professional research; and/or opportunities to plan and carry out their own scientific research projects.

Career Ladder: Youth advance in level of responsibility with increased hours or years of participation, often accompanied by an increase in pay and/or job title.

As shown in Figure 1, there is very little difference between all three types of programs with respect to the features of learning and teaching. That is, program descriptions on the web all describe what the teen participants will learn, and most state that the participants will have opportunities to teach others, such as children in classes and camps or museum visitors. However, descriptions of youth programs are much more likely to mention that the teens will develop life skills, be assigned a mentor or have opportunities to mentor others, and to engage in scientific research. Descriptions of youth programs were more likely to mention that youth would have a mentor or have opportunities to mentor others, than volunteer or internship programs. Similarly, youth programs mentioned life skills more frequently, and only youth programs mentioned research opportunities.

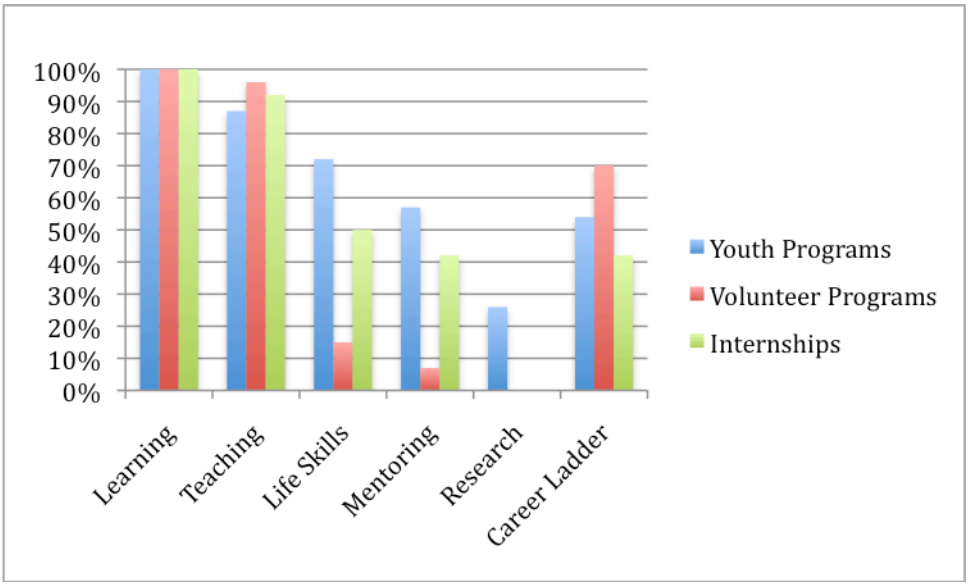

Figure 1. Graph of program features as a function of program type.

When reading the program descriptions, the overwhelming impression is that the three types of programs are very similar. They all emphasize what the teens will gain from the program, and they clearly involve significant commitment by museum educators and curators. Consider, for example, the following youth volunteer program. (Note: quotes from websites are shown in *italics*.)

> Lindsay Museum, Walnut Creek, CA: *The museum's Interpretive Guide program is a year-round program (January–December) that provides teens ages 12–16 the opportunity to learn about animals and nature, explore career opportunities, meet other teens with similar interests and take an active role in our community. Opportunities are available for positive, responsible, enthusiastic teens with an interest in learning about native California wildlife and conservation and who can interact with museum visitors. Interpretive Guides work a 2½ hour shift each week. They are an integral part in the museum's mission of "connecting people with wildlife."*

Experiences for Youth

This section illustrates the kinds of experiences offered to teens in these programs, organized by program features. Percentages given below are for all three types of programs combined (N=163).

Learning. All web descriptions of youth programs describe what the youth will be learning by participating in these programs. Most refer to learning about the nature and content of science as related to the specialties of the organization, with frequent notes about an engaging approach to teaching and learning. For example:

> Crissy Field Center, San Francisco, CA: *The program offers young people a rich combination of experiences including hands-on projects, outdoor investigation and excursions in the field. Youth learn about the biodiversity of Crissy Field by suiting up in waders to explore the marsh, discover the cultural history of the Presidio by hiking along the historic Juan Bautista de Anza Trail, utilize cutting-edge technology in the Center's Media Lab and much, much more!*

Other program descriptions emphasize learning goals that go well beyond science knowledge, such as self-confidence, career aspirations, and leadership. For example:

> Headlands Institute, Sausalito, CA: *Through TEAM, participants discover their inner strength as leaders, their ability to positively influence others, and the importance of diversity, community, and hands-on learning.*

> Carnegie Science Center, Pittsburgh, PA: *The Girls, Math & Science Partnership (GMSP) was created to address issues regarding girls, their participation in science, and the expansion of their opportunities in and influence on the science and technology workforce. Working with girls ages 11-17, their teachers, parents, and mentors, GMSP draws organizations, stakeholders, and communities together in an effort to ensure that girls succeed in math and science. The partnership's mission is to engage, educate, and embrace girls as architects of change.*

Topics and activities tend to be closely related to the home organization's mission. For example, many natural history museums and aquariums focus on environmental issues, such as the example below.

> Peggy Notebaert Nature Museum, Chicago, IL: *TEENS is a paid high school internship program aimed to promote environmental literacy and stewardship through hands-on experiences. Interns develop job and life skills that are applicable to the real world, discover career path options and prepare for college. The TEENS program also completes service learning projects that benefit communities and further the mission of the Nature Museum. Past projects have included butterfly monitoring, community gardening, and prairie restoration.*

Teaching. Most youth programs (91%) list teaching younger students or the general public about science as one of the major activities of the program. The premise of such programs is that opportunities to teach others reinforces knowledge as it increases self-confidence and communication skills. Following are examples of how this element of youth programs is described:

Explora, Albuquerque, NM: *As* [high school] *juniors the interns are paid, part-time employees of Explora. They receive additional training and provide community service by conducting Explora's educational programs for elementary school children . . . . As seniors the interns continue teaching classes on their own, and assist at special events, such as Adventures in Science. They can apply for additional responsibilities, like Birthday Party and Overnight Camp-in Staff positions.*

Museum of Natural History & Science, Cincinnati, OH: *Youth Program participants are taught early childhood theory, developing and presenting educational demonstrations to the visitors. By training our students how to interact and teach our young visitors, Museum Center is excelling in its role as an "investor in community early childhood education."*

Life Skills. For nearly half of all youth programs (44%) life skills are equally important goals as learning and teaching science. This is especially important for programs that aim to serve students from populations historically underrepresented in science and other technical fields. For example:

Miami Science Museum, Miami, FL: *The Miami Science Museum's youth programs focus on providing low income youth with training, mentoring, work experience, academic enrichment and skills in the use of technology, while improving their communication and interpersonal skills and self confidence. The Museum's approach has been profoundly effective, with college and employment success stories attesting to its positive impact. Youth programs provided by the Museum not only provide students an alternative to the streets, but also with a new way of thinking and planning for their futures.*

Mentoring. One third of the youth programs (33%) specifically refer to individual mentoring as a part of the program experience. All of the programs in which youth participate in scientific research involve a mentor. Mentoring can also focus on development of life skills and job counseling. In a few cases participants who have been with the program for two or three years become mentors for younger participants. For example:

Liberty Science Center, Jersey City, NJ: *Now in its 24th year the Partners in Science program provides an eight-week intensive summer experience for high school juniors and seniors. The program pairs students with mentors in health and technical fields and challenges them to participate in research and to undertake independent projects.*

New York State Museum, Albany, NY: *Teens serve as mentors to younger Club kids while developing professional skills from adult mentors.*

Engagement in Research. Approximately one eighth (13%) of youth programs provide opportunities to serve as assistants in research being conducted by professional scientists. For example:

The Yale Peabody Museum of Natural History, New Haven, CT. *EVOLUTIONS (Evoking Learning and Understanding Through Investigations of the Natural Sciences) is an afterschool program that currently serves 125 students in grades 9-12. EVOLUTIONS is a "club" for students interested in science, serious about school and headed to college. Students are paid as interns to work for Yale professors in their laboratories and/or introduce the Peabody Museum teaching exhibits to visitors.*

Project Exploration, Chicago, IL: *We GET students interested in science, KEEP them interested, and EQUIP them with what they need to pursue science. We accomplish this through: interaction and collaboration with scientists; long-term relationships with students; hands-on experiences and fieldwork; year-round youth development activities, reading, writing, and public speaking; and advanced science and leadership opportunities.*

Youth Astronomy Apprenticeship Program, Cambridge and Boston, MA. *Young people are offered learning opportunities in astronomy research during the summer, in working with younger children in afterschool programs during the school year, in designing and building an astrobiology exhibit, and creating a planetarium program. The work opportunities become more challenging over time and require an increasing level of personal responsibility.*

In other cases the teens develop their own research and design projects with the aid of program staff and collaborating researchers:

American Museum of Natural History, New York, NY: *AMNH also offers a NASA Science Research Mentoring Program, which is a multi-year education program for high school students who want to do a supervised internship in the astrophysics or Earth/planetary science departments at the museum. Students take a series of NASA funded courses and work in pairs on research projects under supervision of AMNH scientists, and have opportunities to participate in a STEM summer institute at the City College of New York.*

Career Ladder. About a third of museums and science centers (31%) have career ladder programs like the New York Hall of Science mentioned above. A career ladder refers to a sequence of programs, or steps within a program, in which students move up in rank, status, and/or responsibility as they gain additional experience. Organizations that pay participants typically increase hourly rates as youth advance in rank. Following are three examples of programs that have a career ladder structure.

Brookfield Zoo, Chicago, IL: *The Career Ladder for Youth has provided in-depth experiences for more than 5,000 individuals to date. The program consists of sequential steps designed around individual interests and strengths combined with rewarding opportunities for discovery. Youth climbing the Career Ladder start with the family-based Zoo Adventure Passport program, move on to the after-school Kids' Club, the high school Youth Conservation & Science Corps, and may eventually progress to paid positions, internships, and be eligible for a Women's Board College Scholarship.*

Museum of Science and Industry, Chicago, IL: *The three levels of the Community Initiatives are designed as a pipeline that feed each other. Students in Science Clubs can join Science Minors as teens and go on to become Science Achievers, where they have the chance to go back and facilitate a science club, creating a cycle that connects to the community.*

California Academy of Sciences, San Francisco, CA: *The Careers in Science Intern Program (CiS) is a multi-year, year-round work-based youth development program for young people from groups typically under-represented in the sciences. Primary activities include: learning about science at trainings, lectures, workshops, and conferences; teaching science to the Academy's audiences; conducting scientific work with Academy scientists and in field studies; having fun while working with people from diverse backgrounds.*

Conclusions

Prior reviews of the relationship between museums and schools have primarily focused on numbers of students and teachers served and the kinds of programs offered by different types of museums and science centers. As such they provide little detail on the goals of these programs and the experiences provided to participants. Nonetheless, such studies provide valuable information on how the complementary roles of museums and schools have changed over time.

The purpose of this study has been to provide an overview of extended programs for youth offered by museums and science centers in the United States. The further goal has been to characterize the content and structure of these programs and their frequency. Findings are summarized below.

Broad Base of Youth Programs. A central finding is that at least 163 science centers and museums, or 41% of the moderate to large museums and science centers in the nation, have intensive, in-depth programs for youth. These programs provide a wide range of learning experiences ranging from hands-on workshops and lectures by scientists to field trips, laboratory research projects, and environmental restoration projects. Many of the programs provide adult mentors, and some encourage older and more experienced youth to mentor younger children. Most programs provide opportunities for the participants to teach as well as learn, thereby gaining deeper understanding of science while sharing their knowledge with others.

Volunteer, Internship, and Youth Programs. Although the word *volunteer* specifies that participants will not be paid a wage or stipend, the terms used to describe these programs do not otherwise distinguish the kinds of things that participants will be doing. Although the specific activities and commitments of time differ from organization to organization, students in all three types of programs are likely to be doing the same sorts of things—learning science, teaching younger children or the public, conducting research, and contributing to their communities.

Focus on Girls and Underrepresented Populations. A strong commitment to serving girls and students from populations historically underrepresented in science or related fields is evident among many of the programs—especially those identified as "youth programs." Some of these programs are designed specifically to serve girls, and others recruit youth from low-income families or young people at risk of dropping out of school. A number of program descriptions state that they do not preferentially choose students with good grades in science, but rather students who have an interest in science and a desire to help others or improve the environment.

Indicators of Success. Several of the institutions that recruit students who are at risk of dropping out of school emphasize youth development goals such as engagement in team activities, community service, developing job skills, preparing resumes, visiting colleges and preparing college applications. While websites do not typically publish evaluation studies, discussions with program leaders suggest that most youth programs are evaluated, usually as a condition for funding. Some of these evaluations involve longitudinal research, to determine what happens to the students after participating in a multi-year youth program.

Career Ladder Programs. There are many programs with a well-articulated sequence of steps, so that students can advance in rank and responsibility over time. Dissemination of the career ladder model has had a major boost by the New York Hall of Science, which has conducted in-depth programs for other museum staff in how to develop a career ladder program.

Youth Programs for Middle School Students. The majority of volunteer, internship, and youth programs are for teens, around ages 14-18. However, some museums, such as Chicago's Museum of Science and Industry, include "feeder programs" at the elementary and middle school levels to expand the pool of interested youth.

In summary, the fact that 163 museums and science centers offer extended youth programs, including many with a rich variety of science offerings and growth opportunities, is a very exciting development in the informal science education field and is a testament to the legacy of *YouthALIVE!*. Together these institutions are currently supporting thousands of young people in extended programs which have the potential to expand their future prospects in life, reduce the achievement gap, and increase the diversity of our nation's scientific and technical workforce.

Recommendations

Recommendation 1: Support current youth programs at museums and science centers, and encourage the establishment and growth of new programs to expand the opportunities for our nation's youth to experience the engagement, capacity, and continuity they need to succeed in technical careers.

A seminal paper by Eric Jolly, Patricia Campbell, and Lesley Perlman (2004) proposes three factors that are essential for student success: *engagement* to increase student interest and motivation; *capacity* to gain knowledge and skills, and *continuity* of material resources and guidance by caring individuals. The need for engagement, capacity, and continuity is especially acute for girls, children of color and youth from low-income communities, who face many barriers to entering STEM fields. The programs described in this paper provide all three factors for success. In fact, that is why *YouthALIVE!* was conceived in the first place. Consequently, the most important recommendation is that such programs be supported and encouraged to grow.

Recommendation 2: Re-establish a network of youth program leaders with a strong central staff to strengthen and grow the field.

Our larger landscape study included structured interviews with leaders of twelve youth programs, which focused on policies and operational processes including: goals, recruitment, application and acceptance policies and processes, activities, incentives, evaluation, challenges, future plans, and staffing. Although the findings from these interviews are beyond the scope of this paper, we can say that the leaders we interviewed have tremendous depth of knowledge and experience in conducting youth programs. For example, some leaders described extensive recruitment methods that enabled staff to develop rapport with the youth well before applications were due. Others described programming that built on the participants' initial interests, and that balanced science instruction with youth development. Also important were changes that took place in the programs as they grew over time, such as the need to assess individual performance when a career ladder was introduced.

It was clear from these interviews that youth leaders have a great deal to learn from each other; whether it be staff members who are just starting programs, or veterans struggling with the ongoing problems of funding and maintaining institutional support through changes in leadership. We also found that although the leaders we talked to were in touch with a few of their

colleagues, none of them had a broad view of just how many youth programs existed nationwide, or the commonalities among youth programs, teen volunteer programs, and internships.

While we hope that this paper will support networking by sharing a large list of institutions that have youth programs, developing a strong network will require centralized support. As the organization that initiated *YouthALIVE!,* and the primary convener of museum and science center leaders in the world, ASTC would be the natural leader of such a network. The American Association of Museums (AAM) might also develop a national network of youth programs given its wider membership, including art and history museums, or the Association of Zoos and Aquariums (AZA), which represents institutions that are well-positioned to engage youth in the many careers related to animal care and conservation.

Whatever organization takes the lead, it will be important to establish a strong central office for youth programs that would be able to not only facilitate communication, but to also undertake such projects as publishing a newsletter for youth leaders, compiling evaluation studies, developing monographs on specific topics common to youth programs, and developing periodic training programs for youth leaders. A central office could also undertake major evaluation and research studies that involve several different programs, as described in Recommendation 3.

Recommendation 3: Conduct research and evaluation studies to bring to light the major outcomes of intensive, multi-year programs for youth, and to determine which practices are most effective.

Evaluation studies by third party professionals are costly. However, as several of the youth program leaders that we talked to explained, they are essential for improving program operations and for persuading funders that the program is worth supporting. Although the evaluation studies we have reviewed are well-conceived and useful documents, they are all focused on single youth programs.

Collaborative studies involving several youth programs would have several advantages. First, there are economies of scale. Evaluators have to carry out a number of tasks—investigating the goals, purposes, and operations of a program, designing the study, creating instruments to collect data, writing and testing interview protocols, establishing a database for storing information on alumni, conducting data analyses, and so on. A single large study of several programs would be far less expensive than several smaller studies since most of these tasks need only be done once.

Studies of multiple sites also have the potential to conduct research by comparing the results of different approaches using a single set of instruments. While it will be challenging to isolate variables, since sites differ along a number of dimensions, the challenge is no greater than educational studies that compare other kinds of interventions. For example, some sites offer hourly wages, others offer stipends and college scholarships, and still others do not pay youth at all. It may be possible to investigate the effects of these different incentives on youth commitment, persistence, and eventual academic and career trajectory.

These recommendations are directed at several audiences. Museum and science center directors, presidents, board members, and senior staff members who have the responsibility of deciding how best to allocate limited resources. Another important audience is the philanthropic community that plays such an important role in supporting science centers and museums, making such programs as *YouthALIVE!* possible. Equally important are the leaders of museum

organizations such as ASTC, AAM and AZA that are well positioned to serve a networking and leadership role to support their membership. Perhaps most important are the many staff members at museums, zoos, aquaria, and science centers that personally engage with youth on a daily basis, who may be heartened to know that they are not alone. There are many others throughout the United States, and (although not included in this survey) throughout the world, who share their passion and dedication to serving today's youth—and tomorrow's citizens—by introducing them to the exciting world of science and learning.

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Table 2. Youth Programs Associated with Museums and Science Centers

	YA! Grantee	Learning	Teaching	Life Skills	Mentoring	Research	Career Ladder
Youth Programs							
(The) Academy of Natural Sciences, Philadelphia, PA	*	√		√			√
American Museum of Natural History, New York, NY		√			√	√	√
Audubon Zoo, New Orleans, LA	*	√	√	√			
(The) Bakken Library and Museum, Minneapolis, MN		√			√	√	
Birmingham Zoo, Birmingham, AL		√	√	√	√		
Boonshoft Museum of Discovery, Dayton, OH		√	√			√	
Boston Children's Museum, Boston, MA	*	√	√	√	√		√
Boston University, Upward Bound Math Science, Boston, MA		√	√	√	√	√	√
Brookfield Zoo, Chicago, IL		√	√				√
Bruce Museum, Greenwich, CT		√	√	√			
Buffalo Museum of Science, Buffalo, NY	*	√	√	√			√
Burpee Museum of Natural History, Rockford, IL		√	√				√
California Academy of Sciences, San Francisco, CA	*	√	√	√	√	√	√
California Science Center, Los Angeles, CA	*	√	√	√	√		√
Carnegie Science Center, Pittsburgh, PA	*	√		√	√		
Chabot Science Center, Oakland, CA	*	√	√	√			√
Children's Discovery Museum of San Jose, San Jose, CA	*	√	√	√			
Cincinnati Museum Center at Union Station, Cincinnati, OH	*	√	√	√	√		√
Children's Museum of Indianapolis, Indianapolis, IN	*	√	√	√	√		
Cleveland Museum of Natural History, Cleveland, OH		√					
COSI, Columbus, OH		√		√	√		√
Coyote Point Museum, San Mateo, CA		√	√	√	√		√
Crissy Field Center, San Francisco, CA		√	√	√			√
Denver Museum of Nature and Science, Denver, CO		√			√	√	√
Discovery Center Museum, Rockford, IL		√	√				
Discovery Gateway Children's Museum, Salt Lake City, UT		√	√				√
Discovery Place, Charlotte, NC	*	√	√	√	√		
(The) Discovery Science Place, Tyler, TX		√	√	√	√		√
ECHO Lake Aquarium and Science Center, Burlington, VT	*	√	√	√			√

	YA! Grantee	Learning	Teaching	Life Skills	Mentoring	Research	Career Ladder
Youth Programs (continued)							
Evansville Museum of Arts, History, and Science, IN		√	√				√
Evergreen Aviation and Space Museum, McMinnville, OR		√	√	√	√		
Explora, Albuquerque, NM		√	√	√	√		√
Exploratorium, San Francisco, CA	*	√	√				√
Fairbanks Museum and Planetarium, St Johnsbury, VT		√	√	√	√		
Fernbank Science Center, Atlanta, GA		√	√				
Four Corners School of Outdoor Education, Monticello, UT		√	√	√			
Franklin Institute, Philadelphia, PA	*	√	√	√	√	√	
Museum of Science, Boston, MA	*	√	√	√	√		
Hagley Museum and Library, Wilmington, DE		√	√	√			
Intrepid Sea Air & Space Museum, New York, NY		√	√	√			
Lawrence Hall of Science, Berkeley, CA	*	√	√	√		√	√
Liberty Science Center, Jersey City, NJ		√	√		√	√	√
Lied Discovery Children's Museum, Las Vegas, NV	*	√	√	√	√		√
Long Island Children's Museum, Garden City, NY		√	√	√	√		
MIT, Youth Astronomy Apprenticeship, Cambridge, MA		√	√	√	√	√	√
Miami Science Museum, Miami, FL	*	√	√	√	√	√	
Monterey Bay Aquarium, Monterey, CA		√	√	√	√	√	√
Morehead Planetarium and Science Center, Chapel Hill, NC		√			√		
MOSI (Museum of Science & Industry), Tampa, FL	*	√	√	√			
(The) Museum of Flight, Seattle, WA		√	√				
Museum of Natural History & Science, Cincinnati, OH		√					
Museum of Science and Industry, Chicago, IL		√	√	√	√		√
Museum of Science, Boston, MA	*	√	√	√	√		√
Museum of the Earth, Ithaca, NY		√				√	
National Aquarium, Baltimore, MD	*	√	√	√	√		√
New England Aquarium, Boston, MA	*	√	√	√	√	√	√
New Jersey Academy for Aquatic Sciences, Camden, NJ	*	√	√	√	√		√
New York State Museum, Albany, NY	*	√	√	√	√		√
Oregon Museum of Science and Industry, Portland, OR	*	√	√	√			√

	YA! Grantee	Learning	Teaching	Life Skills	Mentoring	Research	Career Ladder
Youth Programs (continued)							
Pacific Science Center, Seattle, WA		√	√				√
Pittsburgh Children's Museum, Pittsburgh, PA	*	√	√	√	√		√
Project Exploration, Chicago, IL		√	√	√	√	√	
Saint Louis Science Center, St. Louis, MO	*	√	√	√		√	√
San Francisco Zoo, San Francisco, CA		√	√				
Santa Barbara Museum of Natural History, Santa Barbara, CA	*	√	√	√	√	√	√
Science Museum of Minnesota, St. Paul, MN	*	√	√	√	√	√	√
Science Museum of Western Virginia, Roanoke, VA		√	√	√			
Shedd Aquarium, Chicago, IL		√	√	√			
Stepping Stones Museum for Children, Norwalk, CT		√	√	√	√		√
Sun 'n Fun: Florida Air Museum, Lakeland, FL		√	√				
Thanksgiving Point Institute, Lehi, UT		√	√		√		
University of Chicago, Space Explorers, Chicago, IL		√	√	√	√	√	
Wings of Eagles Discovery Center, Horseheads, NY		√	√	√			
(The) Works, Newark, OH		√	√	√	√		
Yale Peabody Museum of Natural History, New Haven, CT		√	√	√	√	√	√
Zeum, San Francisco, CA		√	√	√	√		√
Volunteer Programs							
Adventure Science Center, Nashville, TN		√		√			√
Anchorage Museum and Imaginarium Discovery Center, Anchorage, AK		√	√				
Ann Arbor Hands-On Museum, Ann Arbor, MI		√	√				
Anniston Museum of Natural History, Anniston, AL		√					
Austin Children's Museum, Austin, TX	*	√	√	√	√		
Betty Brinn Chiildren's Museum, Milwaukee, WI		√	√				
Catawba Science Center, Hickory, NC	*	√					
Children's Museum at Holyoke, Holyoke, MA	*	√	√				
Children's Museum of Houston, Houston, TX		√	√	√	√		
Children's Science Explorium, Boca Raton, FL		√	√				
Clay Center for the Arts and Sciences of West Virginia, Charleston, WV		√	√				
Cleveland Children's Museum, Cleveland, OH		√	√				

	YA! Grantee	Learning	Teaching	Life Skills	Mentoring	Research	Career Ladder
Volunteer Programs (continued)							
Delaware Museum of Natural History, Wilmington, DE		√	√				
Detroit Science Center, Detroit, MI		√	√				
(The) Discovery Center for Science and Technology, Westlake Village, CA		√	√				
Discovery Center of Idaho, Boise, ID		√	√				
Discovery Science Center, Santa Ana, CA		√	√				
Ecotarium, Worcester, MA	*	√	√	√			
Family Museum, Bettendorf, IA		√	√				
(The) Field Museum, Chicago, IL		√	√				
Florida Museum of Natural History, Gainesville, FL		√	√				
Fort Discovery, National Science Center, Augusta, GA		√	√				
G.WIZ - The Science Museum, Sarasota, FL		√	√				
Happy Hollow Park and Zoo, San Jose, CA		√	√				
(The) Health Museum, Houston, TX		√	√	√			
Heard Natural Science Museum & Wildlife Sanctuary, McKinney, TX		√	√				
High Desert Museum, Bend, OR		√	√				
Highlands Museum & Discovery Center, Ashland, KY		√	√				
Hudson River Museum, Yonkers, NY	*	√	√	√			
Huntington Botanical Gardens, San Marino, CA		√	√				
Imagination Station, Toledo, OH		√	√	√			
Insights El Paso Science Museum, El Paso, TX		√	√				
LaHabra Children's Museum, La Habra, CA		√	√	√			
Lindsay Wildlife Museum, Walnut Creek, CA		√	√	√			
Louisville Science Center, Louisville, KY		√	√				
Madison Children's Museum, Madison, WI		√	√				
(The) Magic House—St. Louis Children's Museum, St. Louis, MO		√	√				
Marine Mammal Center, Sausalito, CA		√	√		√		
(The) Mary Brogan Museum of Art and Science, Tallahassee, FL		√	√				
Mid-America Science Museum, Hot Springs, AR		√	√		√		
Mid-Hudson Children's Museum, Poughkeepsie, NY		√	√				
Minnesota Children's Museum, St. Paul, MN		√	√				

	YA! Grantee	Learning	Teaching	Life Skills	Mentoring	Research	Career Ladder
Volunteer Programs (continued)							
Muncie Children's Museum, Muncie, IN		√	√				
Museum of Arts and Sciences, Macon, GA		√	√	√			√
Museum of Discovery, Little Rock, AR		√	√				
Museum of Life and Science, Durham, NC	*	√	√				
(The) Museum of Natural and Cultural History, Eugene, OR		√	√				
Museum of Science and Industry, Jacksonville, FL		√	√				
National Zoo, Washington, DC		√	√				
Natural History Museum, Los Angeles County, CA		√	√				
New Mexico Museum of Natural History and Science, Albuquerque, NM		√	√				
Newark Museum, Newark, NJ	*	√	√	√			√
North Carolina Museum of Natural Science, Raleigh, NC		√	√				
Oakland Zoo, Oakland, CA		√	√				
Orlando Science Center, Orlando, FL	*	√	√				
Owensboro Museum of Science and History, Owensboro, KY		√	√				
Philadelphia Zoo, Philadelphia, PA	*	√	√				√
Randall Museum, San Francisco, CA		√	√				
Roger Williams Park Zoo, Providence, RI	*	√	√				√
San Diego Natural History Museum, San Diego, CA		√	√				
Sci-Tech Discovery Center, Frisco, TX		√	√				
Science Center of Iowa & Blank IMAX Dome Theater, Des Moines, IA		√	√				
Sciencenter, Ithaca, NY	*	√	√				
Science Place and the Museum of Nature and Science, Dallas, TX	*	√	√				
South Florida Science Museum, West Palm Beach, FL		√	√				
Sternberg Museum of Natural History, Hays, KY		√	√				
Turtle Bay Exploration Park, Redding, CA	*	√	√				
Upper Penninsula Children's Museum, Marquette, MI	*	√	√	√	√		
Virginia Air and Space Center, Hampton, VA		√	√				
Virginia Discovery Museum, Charlottesville, VA		√	√				
Virginia Living Museum, Newport News, VA		√	√				
Virginia Museum of Natural History, Martinsville, VA		√	√				

	YA! Grantee	Learning	Teaching	Life Skills	Mentoring	Research	Career Ladder
Volunteer Programs (continued)							
Western North Carolina Nature Center, Asheville, NC		√	√				
Whitaker Center for Science and the Arts, Harrisburg, PA		√	√				
William McKinley Presidential Library and Museum, Canton, OH		√	√	√			
Internship Programs							
A.G. Gilberts Discovery Village, Salem, OR		√	√				
(The) Adler Planetarium and Astronomy Museum, Chicago, IL		√	√	√			
California Academy of Sciences, San Francisco, CA	*	√	√	√	√	√	√
Children's Museum of Manhattan, New York, NY		√	√	√	√		√
DNA EpiCenter, New London, CT	*	√	√	√	√		√
Haffenreffer Museum of Anthro., Providence, RI		√	√		√		
Headlands Institute, Sausalito, CA		√	√	√	√		√
National Museum of Natural History, Washington, DC		√					
New York Hall of Science, Flushing Meadows, NY	*	√	√	√	√		√
Peggy Notebaert Nature Museum, Chicago, IL	*	√	√	√			√
Reuben H. Fleet Science Center, San Diego, CA		√	√				
Science Museum of Virginia, Richmond, VA		√	√				
WonderLab Museum of Science, Bloomington, IN		√	√				