

Miami Museum of Science & Planetarium Mentoring Programs for Underserved Youth

Introduction

As an integral part of its educational mission, the Museum has created, tested and refined a powerful model for engaging traditionally under-represented youth in the fields of science, technology, engineering and mathematics (STEM), with mentoring as the cornerstone of the model's success. Building on partnerships with area colleges and universities, and drawing on the richness and diversity of its own staff, the Museum provides youth program participants with ongoing support from college-level and professional mentors, inspiring and encouraging exploration of science content and careers in the Museum's informal learning environment. Through a combination of academic enrichment opportunities, technology integration, internship experiences and college prep, Museum mentors have provided science-rich learning opportunities to over 1,000 students representative of Miami's culturally and ethnically diverse community, with 96% going on to college and 60% pursuing STEM-related careers.

Background

Education has been at the heart of the Miami Museum of Science and Planetarium since its founding by the Junior League of Miami in 1949. Through a diversity of exhibits and educational programs, the Museum strives to provide informal learning opportunities to increase the science literacy of all individuals, serving nearly 300,000 visitors annually, including 100,000 area students. Over the past decade, building on a resolution of the Museum's Board of Trustees, the Museum has focused many of its educational programs on the needs of traditionally underrepresented groups with the aim of increasing *access* to science education resources and science learning experiences, facilitating the active pursuit of science, mathematics and technology education and careers.

The majority of the students participating in the Museum's youth programs are drawn from Region IV of Miami-Dade County Public Schools (M-DCPS). The fourth largest school district in the nation, M-DCPS mirrors the challenges facing schools nationwide. The district has an extraordinarily diverse student population, with 29% percent of all students African American and 58% Hispanic. Miami was recently named the poorest large city in America, supported by the fact that nearly 62% of students are on free- or reduced lunch, with one-third of all children in the County under the age of 17 living in poverty. In 2002-2003, 15 of the District's 38 high schools received an overall performance grade of D or F. For the same period, 51% of the district's 10th graders scored below average on the Florida Competency Assessment Test in mathematics.

Goals and objectives of Museum Mentoring Program

The overall goal of the Museum's youth mentoring program is to contribute to the equity and diversification of the nation's science, technology, engineering and mathematics pipeline. In support of this goal, specific objectives of the Museum's integrated mentoring initiatives include

- Providing access to science-rich learning experiences for traditionally underrepresented youth, increasing their participation in science, technology and engineering-related studies and careers;
- Increasing interest and participation in STEM activities among middle school girls, with emphasis on girls of color;
- Documenting effective strategies for providing mentoring in science-rich informal learning environments as a means of raising interest in STEM fields and
- Sharing successful strategies and the results of Museum mentoring initiatives with informal science education communities, thereby providing leadership to the field of science education.

Long-term significance of Museum Mentoring Programs

The Museum's youth mentoring programs respond to the continued need for high-quality, proven models aimed at increasing the representation of underserved groups in the fields of science, technology, engineering, and mathematics. Nationally, K-12 student achievement in mathematics and science continues to pose concerns, particularly low achievement among minorities. According to the 2000 National Assessment of Educational Progress, overall student achievement in science has stayed the same since 1995 at the 4th- and 8th grade level, with only 29% of 4th graders and 32% of 8th graders scoring at or above proficiency, while achievement at the 12th grade level declined from 21% to 18%. Minority students scored lower than white students in science at all grade levels, with only 3% of Blacks and 7% of Hispanics scoring at or above proficiency by the time they reach 12th grade. Science score gaps also widened for females at the 4th and 12th grade level (NCES, 2002). Internationally, according to recent TIMSS-R data, the performance of U.S. students in both mathematics and science declined relative to the international average among those who were in 4th grade in 1995 compared with those who were in 8th grade in 1999 (NCES, 2001).



Low achievement in science and mathematics has continued to translate into low postsecondary enrollment, retention and degree attainment in quantitative fields, especially among minorities. Although minority groups have made gains over the last decade in attainment of STEM degrees, African-American and Hispanic undergraduates are still more likely than Whites or Asians to pursue degrees in the social or behavioral sciences (NSF, 2003, p. 25). Blacks still earned only 8% of S&E degrees, and Hispanics only 7%, below their 11-12% representation in the overall population (NSF, 2003, p. 32). Women still earn only 28% of all S& E doctoral degrees (p. 48), while African Americans and Hispanics both still account for only 4% of all science and engineering Ph.D.s (p. 51).

In a recent report titled *Upping the Numbers*, Campbell et al. explore where and why minorities leave the pipeline leading to employment in science-based fields, noting that if minorities and women were represented in quantitative disciplines in proportion to their representation in the population, there would be a million additional workers in these areas. The report specifically acknowledges the important role played by special programs such as those offered by science centers and museums in terms of providing hands-on learning opportunities, tutoring, college prep, orientation programs, mentoring and other forms of support (Campbell, 2003).

Approach

The Museum's youth development model engages youth in science inquiry, involving them in the process of science, and increasing their science literacy and interest in science-related careers. Mentoring lies at the heart of this model, providing the underlying framework for the delivery of a range of activities including hands-on science activities within an informal but real-world context; technology training and utilization to produce meaningful products; real-world research experiences; career awareness, and college prep. By



equipping students with the motivation, support, tools, and access to explore science-based careers, the model has been shown to lead to improved academic achievement, increased college attendance, and increased pursuit of science and technology related careers.

In conducting hands-on investigations as part of their Museum experience, participants are typically assigned to small teams, and to enhance the project-based learning experience, a **college mentor** is assigned to each team. In recruiting college students to assist in the delivery of its youth development programs, the Museum takes into consideration the ethnic and cultural diversity of its program participants, the majority of whom are African-American, Afro-Caribbean, or Hispanic. Drawing on the diverse population of students attending area universities, the Museum identifies undergraduates of similar backgrounds who are majoring in STEM-related fields including engineering, computer science, chemistry, and biology. To equip them for their role, all mentors receive training on appropriate mentoring techniques, facilitating small team dynamics, promoting science inquiry through hands-on investigation, conflict resolution, and first aid. Mentors work closely with participants, assisting in the delivery of programming, accompanying student teams into the community as part of the project-based investigations, and accompanying participants on the college tours. Equally importantly, the mentors serve as valuable role models to students, who often have very stereotyped notions about scientists and researchers.

Museum science educators directing specific projects work closely with the college mentors to implement project activities, providing a further level of mentoring. The Museum's informal learning environment and the project-based approach are conducive to establishing rapport with the participants, allowing the directors and staff of the Museum's multi-year youth development initiatives to form close relationships with many of the participants.

In addition to staff assigned to particular projects, **professional staff** throughout the Museum are paired with individual students, building mentoring relationships that frequently span several years, providing continuity of guidance and support.

Key Programs

As described above, the Museum has been active in youth development programming for over a decade, reaching more than 1,000 students to date. The Museum's Department of Educational Opportunity Programs coordinates an integrated set of projects, funded by a variety of donors, all in support of increasing access to science learning opportunities among traditionally underserved groups. The multi-year Upward Bound Math & Science Center program serves as the umbrella for current youth development and mentoring initiatives, providing a continuous four-year experience for up to 50 students per year, with mentoring and other Museum support frequently extending into the students' college years. Funding from other donors is used to extend the size of this core participant pool to approximately 75 per year, and to add additional content strands, in such areas as biotechnology, environmental science, and science education. Equity initiatives currently focus on the middle school level but extend into the Upward Program as some of the participants (8 girls, to date) avail themselves of the opportunity to enter into Upward Bound, effectively continuing their association with the Museum from middle school through graduation. A recent longitudinal study of a subset of 475 Upward Bound participants showed that 80% of participants choose to remain active in Museum programming all the way through high school, testifying to the value of the program and the commitment of staff, mentors and participants.

The ethnic and demographic composition of program participants reflects the diversity of Miami's community. Cumulatively, 73% of youth program participants have been African American/Afro-Caribbean, and 23% Hispanic. Reflecting the Museum's commitment to achieving gender equity in science learning, 63% of overall program participants have been female. Over 70% of participants are the children of first-generation immigrants; 80% come from families that are both low-income and in which the participant will be the first member of the family to go to college. The majority of participants also reside in single-parent homes, with large numbers of siblings, compounding the obstacles faced by the participants.

The following section provides details related to the primary activities carried out in the main projects, including key accomplishments and outcomes.

1. Multi-year youth development initiatives

The high school youth development program is currently supported by two major sources of support, both multi-year in nature. As described above, Upward Bound, serves as the umbrella, to which the Museum adds new content strands through alternate funding sources. Currently, a biomedical focus is supported through funding from the National Institutes of Health under their Science Education Partnership Award. The use of mentors is the critical program component that runs through all youth development efforts, as described below.

Without the mentors at the Miami Museum Of Science, going to college would have been like an unrealistic dream. Today I am well ahead of my peers, on track and on the road to success.
- Valencia Charles, 12th grade, Miami High

Upward Bound Math & Science Program:
IMPACT (Integrated Marine Science and College Training)

The cornerstone of the Upward Bound program is an intensive 6-week marine science program. Students are exposed to a variety of marine science disciplines through hands-on activities, site visits, field research, a professional lecture series, and team projects. A total of fifty students are served, spanning four grade levels – rising 9th graders through rising 12th graders. Students in each grade level are guided through the program by two **college mentors** who are currently studying, or recently graduated from, a marine biology or other environmental science discipline. This model is successful for several reasons. First, great care is taken in the recruitment of mentors to ensure that they not only have the science content knowledge required to teach the curriculum, but also to provide students with mentors who reflect their own background in terms of ethnicity, gender, and often, socio-economic backgrounds. Further, since the college mentors are only a few years ahead of program participants in their schooling, they provide a valuable source of information and encouragement to students. The model also allows for a very low student to mentor ratio, with each mentor leading a team of six to eight students for the summer.



In addition to college mentors, the students are also exposed to **professional mentors** through a weekly lecture series, site visits and field research excursions. The Upward Bound partnership with University of Miami's Rosenstiel School of Marine and Atmospheric Science is critical in finding scientists who are both willing to participate in the program and who have proven to be influential with teenagers. These scientists provide professional role models that participants are not exposed to in their homes and neighborhoods, again taking care to find professional mentors who reflect the student's backgrounds.

At the conclusion of the Upward Bound summer program, students are encouraged to continue their participation. During the school year, students are engaged in programming in both the after-school hours and on Saturdays. The after-school program includes tutoring, SAT preparation and academic advising. Students have access to the Museum's state-of-the-art computer facility to do homework assignments and Internet research. Mentors are a key variable in the equation. Each day, as many as five tutors are available to assist the participants with their schoolwork. The tutors are provided through the work-study program at the University of Miami, linking participants on a daily basis with college role models who continuously mentor them through their high school years. SAT preparation courses are also provided, in partnership with The Princeton Review, by a college mentor. These sessions help students to navigate the college application process -- a process that their parents are not able to guide them through.



Participants are also engaged on Saturdays through a variety of project-based science enrichment courses that include hands-on activities, site visits, field trips and guest speakers. Where possible, mentors who worked with participants during the summer program continue to act as mentors during the school year program, further strengthening the mentoring model. In addition to college mentors, participants are also mentored by youth program staff. Unlike in the formal education system, mentors in an informal institution have a broader opportunity to be involved in their students' lives outside the "classroom." Youth program mentors

often have dinner with participants' families, go to the movies together, or take group camping trips throughout the state. In addition, many of the Museum's professional staff choose to act as mentors either in the context of their work at the Museum or on a more personal level.

BioMedical Training, Research, and College Prep (BioTrac)

Funding from NIH has allowed the Museum to expand its multi-year offerings to youth by providing a biomedical content strand. BioTrac has exposed not only the Upward Bound students but an additional 25 underrepresented students to opportunities leading to postsecondary study and careers in the health sciences. The mentoring model used in BioTrac mirrors the one used in Upward Bound, with two additional elements involving professional mentors. First, the BioTrac program hosts a career fair each year, at which a variety of biomedical professionals participate and share stories about their educational paths and career choices. The fair is an important element in exposing participants to the breadth and depth of career choices available to them. Many of the professionals subsequently continue to support participants through e-mail and phone exchanges.

*"Today was an awesome day! I loved the discussion we had and the lab we performed. Most of the things that we spoke about were very familiar to me, but it really helped me understand the concept better. I think this class will help me a lot, especially because I am in Biology III AP. It's ironic how much I've learned from the mentors in the pass two weeks compared to what was taught to me in the past two years in Biology." – **Santiana Jean-Baptiste, Junior, University of South Florida***



Secondly, rather than a six-week summer program, eight to twelve participants who are either rising 12th graders or college-bound students are selected for eight-week internships with research scientists at the University of Miami School of Medicine. These **professional mentors** work side by side with BioTrac interns, engaging them in their ongoing research projects.

"The highest compliment is that 'your student' is mistaken for a pre-med student. Her poise and conduct make your program shine"
- Dr. Sanders, Pediatric Mobile Clinic

Placements have included the Pediatric Mobile Clinic, an HIV Retrovirology Lab, The Touch Institute, the Miami-Dade Crime Lab, the City of Miami Morgue, and research labs studying diabetes, teenage pregnancy, nanotechnology, and other biomedical topics, providing participants with an unparalleled experience. Many of these professional mentors remain in contact with their interns well beyond the context of the summer internship.

2. Ongoing Science Education Internship Program

In addition to the program efforts described above, ongoing science education internships in Museum departments give program participants experience in a range of areas including serving as science interpreters in the galleries, as teacher assistants in the Museum's award-winning Summer Science Enrichment Camp, and as Wildlife Center demonstrators. These internships provide another avenue for Museum staff to mentor participants. Depending on the students' individual placement, they may be mentored by the Director of Visitor Services, the Museum's Science Educator, the Wildlife Center Manager, or other professionals at the Museum. These relationships between mentees and mentors often span several years, with mentors not only providing content information but also helping their mentees to develop valuable work, communication and social skills. Further, participants often are able to earn a stipend for their internships, enabling



them to remain active in Museum programming when they might otherwise need to leave to provide financial support for their families. These Museum internships also provide for an additional tier of mentoring – program participants now act as mentors to Museum visitors and camp participants. This not only allows youth program participants an opportunity to give back to the organization, but also to hone their own mentoring skills.

3. Gender Equity

Cutting through the Museum's youth development program is a focus on equity. Given the persistent underrepresentation of women in STEM fields, a key focus has been on increasing the involvement of girls in the science and technology pipeline, with emphasis on girls of color. Over the past nine years, the Museum has received three grants from the National Science Foundation towards that end. The first two focused on engineering; the most recent (Girls Redesigning and Excelling in Advanced Technology, or GREAT) focused on engaging girls in the use of virtual reality software to create exhibits for the Museum galleries.



The Museum's gender equity program starts at the middle school level – the point at which research shows girls begin to drop out of the STEM pipeline – and provides an opportunity for girls to sign on in 7th grade and continue into the Upward

Bound program, staying with the Museum through graduation. Within its equity programs, the Museum uses the mentoring model to engage girls in science and technology, breaking down stereotypes, building confidence, and sparking in girls a genuine excitement about these dynamic fields. The model rests on the premise that girls will feel more inclined to explore these typically male domains in an all-girl, informal, cooperative learning environment. Included is a strong reliance on female college mentors – undergraduates from area universities who are majoring in science- and technology-related disciplines and whose background and characteristics mirror those of the girls. The mentors work with the girls in small teams, providing technical guidance and serving as invaluable role models. Girls take part in hands-on activities that give them the opportunity for self-directed inquiry, allowing them to express and pursue their interests.

Results from the interim evaluation of GREAT show that a majority of participants achieved gains in skill and knowledge related to the use of technology, including gains in use of common hardware tools (i.e., scanners, ZIP drives), networked applications, Internet navigation, multimedia, interactive software applications, and publishing and presentation applications. Also, more participants choose math and science as a favorite subject after participating in the GREAT project, reflecting gains in confidence and interest.



Results of the earlier Raising Interest in Science & Engineering program, which ended in 2000, indicated the project achieved its objective of stimulating girls' interest in STEM and raising their self-confidence about pursuing STEM studies and careers. The majority (72%) of participants attending the 4-week summer engineering academy reported they planned to attend a science or engineering magnet school, over 90% expressed interest in pursuing a STEM-related career, and the majority rated themselves as one of the smartest (40%), or very smart (20%).

“The mentors are really young and they relate to us. We look up to them. They make the work and the learning fun. It’s important that they are girls too. They actually listen to our ideas and opinions. Teachers are too serious. The mentors treat everyone equally.”

- RISE participant, 8th grade

In open-ended interviews, girls were enthusiastic in expressing their thoughts about the project’s four female college mentors. Some girls described the mentors as “big sisters”, and although the mentors were only a few years older, some said they were “like moms.” During informal conversations, many of the girls expressed how much the mentors as female engineering students had influenced their thinking. They said that the fact that most of the mentors were Black or Latino and had attended middle school and high school in the Miami-Dade County Public Schools system, let them know that they too could become successful engineering students. Before attending the Summer Academy, they had very stereotyped ideas about what female engineers would look like. Many said they thought engineers would be “weird.” They said it was very important to them to see that the mentors were attractive young ladies who wore nice clothes and had boy-friends.

Accomplishments

One of the most notable cumulative results of the Museum's youth development and mentoring efforts is a participant graduation rate and enrollment rate in postsecondary education significantly higher than rates at targeted partner high schools and district-wide (see table below). Further, nearly 60% of graduating participants have chosen a STEM postsecondary course of study.

Student Achievement Data (2000-2004)					
	Youth Program Participants	Miami Edison Sr. High	Miami Jackson Sr. High	Miami Senior High	District
Percentage of students graduating	98.7%	37.95%	45.25%	47.25%	53.05%
Percentage of graduating students going on to post-secondary education	96.3%	40.3%	37.2%	54.1%	54.15%



Students graduating from the Museum's youth program and going on to college have been accepted into a wide array of colleges and universities throughout Florida and the rest of the country, including such institutions as Florida State University, University of Central Florida, University of Florida, Princeton University, Reed College, Smith College, Emory University, University of Virginia and University of Arizona. Many have received generous scholarships from such donors as the Hitachi Foundation, the Gates Foundation, PepsiCo and others, in recognition of their academic achievements to date and their dedication to their future goals.

Perhaps one of the most tangible measures of the success of the Museum's program has been the frequency with which graduates of the program have returned to the Museum, during summer and semester breaks, to in turn serve as mentors, working with current youth program participants to share their experiences and lessons learned. Other former youth program participants return to work as science interpreters in the Museum's galleries, and some serve as assistants in the Museum's Summer Science Enrichment Camp. Over the past decade, between 15 and 20 former mentees have returned to the Museum each year to provide their services in a paid capacity, with twice that number returning to make contact with former staff mentors and seek further guidance on such matters as financial aid, letters of recommendation, and changing majors. Through their continued involvement with the Museum beyond their direct participation in the youth programs, these young men and women have continued to benefit from the professional opportunities, financial

The programs at the Museum of Science have opened my eyes to new things, captured my imagination, and aspired me to want more out of life. What the programs have given me are the things that I hope to give back to my community.

**- Rosena Francois, Senior
Florida State University**

opportunities, and continuing guidance and support from Museum staff while themselves contributing to, and enriching, the mentoring experience for the current cohort of students.

Replication & Dissemination of Youth Mentoring Strategies and Results



As indicated above, a key objective of the Museum's youth development programs is to share results and effective strategies with other informal science education institutions nationwide. In particular, the Museum seeks to communicate lessons learned about the pivotal role of sustained mentoring efforts in building participants' confidence and skills to pursue STEM education and careers. As part of the BioTrac National Demonstration Project (described above), the Museum is in the process of developing a detailed guide to mentoring in the context of science-rich youth development programs. Once this is completed, the Museum will host a series of institutes targeting other informal science institutions with youth programs, from around the country. Annual grantee conferences for the U.S. Department of Education-funded Upward Bound project and the NSF-funded GREAT project, and the annual conference of the Association of Science-Technology Centers, have provided additional avenues for sharing the Museum's proven best practices in youth mentoring.

The Museum has also made use of its award-winning website, www.miamisci.org, to document the strategies and results of its youth mentoring initiatives, including many samples and web pages designed by the participants recording and reflecting their science and technology learning experiences (see www.miamisci.org/impact/impact.html, www.miamisci.org/biotrac/, and www.miamisci.org/rise/). The Museum's website receives close to 4 million hits (800,000 page views) per month, making it an important platform for sharing project outcomes.

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