

OPENING MINDS TO SCIENCE

The Saint Louis Science Center's Report to the Community



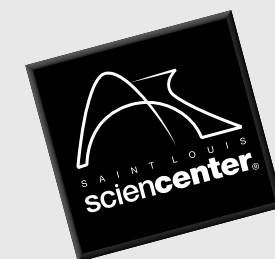
2006-2007



OPENING MINDS TO SCIENCE

The Saint Louis Science Center's Report to the Community

2006-2007



Editor: Jennifer Heim
Publication Design: Jason Cook

ACKNOWLEDGMENTS

The Saint Louis Science Center would like to acknowledge the contributions of the following individuals and groups in the creation and review of this report:

Saint Louis Science Center's Division of Education, Exhibits & Programs*

Collections
Community Science
Design & Creative Services
Exhibit Electronics & Production
Public Programs
Research & Evaluation
School Programs
Science & Galleries
Special Exhibits
Challenger Learning Center~St. Louis

Consultants

Christine Klein, PhD
Joseph L. Polman, PhD

*For a complete list of Education, Exhibits & Programs Staff, see the Appendix.

Cover photos (clockwise from top left):

FIRST Robotics, Healthfest, Summer Science Blast, Ancient Americas Travel Program, Challenger Learning Center-St. Louis (Photo: Ron Bookout, The Boeing Company).

Unless otherwise noted, all photos by the Saint Louis Science Center.

From the Senior Vice-President and Associate Director of the Museum,
Carol Valenta

Dear Partners in Science Education,

It is my great pleasure to introduce *Opening Minds to Science: The Saint Louis Science Center's Report to the Community, 2006-2007*.

Opening Minds to Science offers insight into the experience of Science Center program participants from September 2006 to August 2007. We also spotlight four programs that provide more sustained engagement and look at how participants in these programs have been affected by their experiences. Through this report we seek to provide our community partners and stakeholders with both quantitative and qualitative information about the impact Science Center programs have on our diverse audiences.

Where appropriate, we also include the words of program participants. Their enthusiasm and excitement speak to the power of engaging with science in informal settings, on one's own terms. We hope you will find this report useful to your work and we look forward to your feedback.

Sincerely,



Carol Valenta
Senior Vice President & Associate Director of the Museum
Saint Louis Science Center



Carol Valenta
Senior Vice-President
and Associate Director
of the Museum

CONTENTS

Open Every Mind to Science	1
The Saint Louis Science Center’s educational philosophy and practice.	
Methodology	3
How the Science Center collects and analyzes data describing our programs.	
Overview of Programs at the Science Center, by Department	5
Analysis of programs as a whole, as well as by individual department.	
Challenger Learning Center-St. Louis	7
Community Science Department	8
Public Programs Department	9
School Programs Department	10
Science & Galleries Department	11
Program Spotlight	12
More in-depth analysis of the experience of participants in four Science Center programs.	
<i>Summer Science Blast</i>	12
<i>FIRST Robotics</i>	15
<i>Yes-2-Tech</i>	18
<i>Learning Places</i>	21
Looking to the Future	23

OPEN EVERY MIND TO SCIENCE

The Saint Louis Science Center’s Educational Philosophy and Practice

The Saint Louis Science Center is a free-choice, informal learning environment where people of all ages engage with science – directly and on their own terms. We seek to engage the broadest audience possible through programs designed for: families, school groups, educators, adults, at-risk teens, community organizations, and the general public visiting the Science Center.

Our mission is to stimulate interest in and understanding of science and technology throughout the community.

Opening Minds to Science

Our exhibitions and programs take into account the complete visitor environment – physical, social, and personal. We believe that learning is best fostered through programs and exhibitions that encourage visitors to:

- make personal connections to their knowledge and experiences
- embrace a spirit of play and discovery
- act on their own curiosity
- form and ask questions
- engage in hands-on exploration and experimentation
- cultivate science process skills
- pursue science throughout their lives

Positive experiences with Science Center exhibitions and programs will encourage repeat visits and prompt visitors to interact with science beyond their visit. Ultimately, we hope to motivate our visitors to think differently about science and to empower them to make informed choices in their everyday lives.

Learning in an Informal Environment

Free-choice learning “tends to be non-linear and personally motivated.” (Falk and Dierking, 2000, p.13) In designing our programs and exhibitions, we strive to provide multiple levels of interaction and engagement for diverse audiences. This translates into experiences that are accessible, multi-sensory, and meaningful to people with a variety of abilities, cultural backgrounds, experiences with science, learning styles, and interests. We also seek to support social learning, experimentation, and investigation. We believe visitors should have fun, engaging, relevant, and successful experiences with science, whatever their level of knowledge. Science Center staff play a key role in fostering a successful experience.

How We Develop Exhibitions and Programs

In order to develop exemplary exhibitions and programs, we ground our processes in best practices in the field, current science content, current learning theory, and audience research. Clearly articulated educational goals and objectives drive the exhibition and program development process. As appropriate, we correlate our offerings to national and state curriculum standards. Through front-end, formative, and summative evaluation, we include our audiences and other stakeholders in the program and exhibition development and revision process.

In developing these experiences, we seek to communicate clearly how we envision visitors engaging with them, employing devices such as advance organizers and tools to personalize the experience. We take risks with cutting edge content, ways to deliver that content, and ways of including new audiences. The Science Center supports these processes with adequate time, funding, and staff.

Exhibitions at the Saint Louis Science Center capitalize on the power of three-dimensional environments to engage our community with science. Our exhibitions must engage a broad spectrum of visitors. We recognize that every exhibit component cannot meet all the needs of all our audiences, but we seek to create a balance of experiences within the exhibition as a whole.

We commit to developing exhibitions that:

- Provide multiple conceptual entry points and multiple outcomes.
- Are current and can be adapted to stay current.
- Facilitate conversations and encourage multiple groups to engage with each other.

Programs at the Saint Louis Science Center engage our community with science via skilled, well-trained program developers and presenters. Often developed based on the needs of specific audiences, programs both expand on conversations begun in our galleries and incorporate topics and experiences beyond the scope of our galleries. Consequently, programs increase our audiences' engagement with science and broaden the Science Center's impact. Programs also increase the size and diversity of our audience and generate revenue crucial to our ongoing work.

We commit to developing programs that are:

- Learner-centered.
- Delivered by knowledgeable and well-trained presenters.
- Facilitated in a manner that actively matches content and delivery to the needs of the current audience.

Thoughtful planning supports our exhibition and program development process. A focused and fiscally sound plan, based on this learning philosophy, addresses each of our audiences and content areas. A review process allows us to monitor our impact and track our success toward opening minds to science.

METHODOLOGY

Since 1997, the Saint Louis Science Center has collected information about the experience of participants in our programs through the **Better Education and Revenue Through Tracking (BERTT)** system. The BERTT system collects and summarizes key performance indicators for Science Center educational programs.

At the Science Center, we define programs as, "staff-led interactions scheduled for a specific audience with written educational goals and objectives."

BERTT tracks the following elements related to program performance:

- Average length of a program
- Number of times offered
- Number of interactions (individual's participation in a program)
- Total hours of interaction
- Average mission, satisfaction, and interest ratings by participants (each on a four-point scale, with four as the highest rating)
- Measure of impact on participants (ten-point scale, with ten as the highest score)

Program staff distribute response cards to a sampling of program participants. Visitors are invited to respond to the following questions:

- "Did you, or others in your group, discover something interesting from the activity today?" (**Mission Question:** Measures how well the Science Center is accomplishing its mission of stimulating interest in and understanding of science and technology throughout the community.)
- "How satisfied were you with this program today?" (**Satisfaction Question:** Measures how satisfied participants are with the program.)
- "How much did previous Science Center experiences influence your decision to participate in this program?" (**Interest Question:** Measures the influence of past visits on the decision to participate in program.)

Participants are also asked to respond to the following open-ended question:

- "What was the highlight of your experience in this program today? Why?" (**Highlight Question**) The open-ended responses to this question are coded for analysis.

A version of the response cards with child-friendly language is distributed to participants under the age of 14.

Program staff enter the responses into a shared database. This database allows the Research & Evaluation Department to calculate average length, interactions, and participant ratings for specific programs, departments, and Science Center program offerings as a whole. This information is analyzed and presented in monthly, quarterly, and end-of-year reports, in addition to this annual report to our community stakeholders.

Defining and Measuring Impact

On an individual level, impact results from a Science Center offering that enables a participant to make personal connections between the content and experience of the offering and their own knowledge and experiences.

In the short-term, this is illustrated by a change in knowledge, understanding, attitude, interest, or enjoyment. Over the long term (months to years), this is illustrated by an incorporation of these changes into participants' lives. The larger effects of these long-term individual impacts are felt within the Science Center and throughout the broader communities of which the Science Center is a part.

The impact score provides a numerical way to represent the impact program participation has on an individual. The mission, satisfaction, and interest ratings, as well as participants' responses to the highlight question, contribute equally to the calculation of the impact score, which is reported on a ten-point scale.

In addition to the ongoing program measures collected and reported on a monthly, quarterly, and annual basis, the Science Center also conducts more in-depth evaluation of selected programs. Periodically, the Science Center contracts with external evaluators to conduct front-end, formative, and summative evaluations on specific programs. This report contains findings from both internal evaluations conducted by the Science Center's Research & Evaluation Department as well as evaluation studies conducted by external evaluators. Unless otherwise noted, data and findings originate from the Research & Evaluation Department.

OVERVIEW OF SAINT LOUIS SCIENCE CENTER PROGRAMS

September 2006 to August 2007

Broad View of Program Interaction

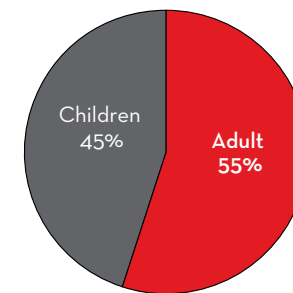
From September 2006 to August 2007, the Saint Louis Science Center offered approximately 100 distinct programs to children, school groups, teachers, families, and adults. Some of these programs were one-time offerings; many were offered multiple times. The Science Center tracks each time an individual participates with a program and references this participation as an "interaction". The duration of these interactions can range from a 15 minute *Amazing Science Demonstration* to a multi-day experience such as a camp or travel program. Individuals engaged in over 400,000 interactions with Science Center programs during this time period, for a total of 432,742 hours of engagement. The average amount of time participants spent with Science Center programs was slightly over an hour.

From these program interactions, BERTT cards (please see page 3 for a description of the BERTT system) were collected from a little over 11,000 program participants for a return rate of 3%. Respondents gave the following average ratings:

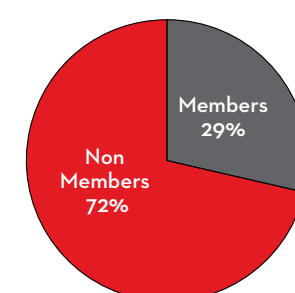
- Mission: 3.72 (out of 4)
- Interest: 3.31 (out of 4)
- Satisfaction: 3.59 (out of 4)
- Impact: 8.43 (out of 10)

Characteristics of Respondents

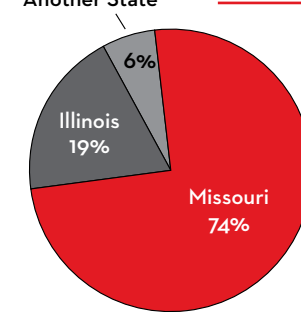
ADULTS & CHILDREN



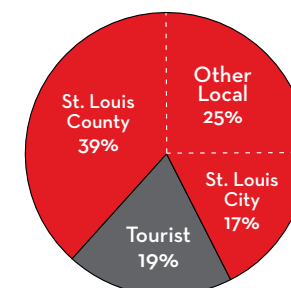
MEMBERSHIP STATUS



RESIDENCY

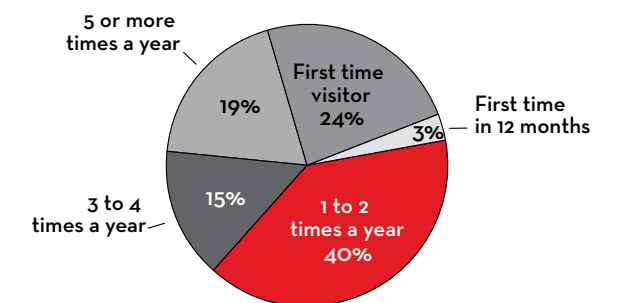


By State



Local* vs. Tourist

VISITATION FREQUENCY



Analysis of Ratings by Age, Membership, Residence, and Visitation Frequency

As illustrated in the table below, on average, children gave significantly lower ratings than adults for the mission question (3.66, 3.79) and satisfaction question (3.57, 3.60). Children gave significantly higher ratings than adults for the interest (3.58, 2.96) question. Also, the impact score for children was significantly higher than for adults (8.67; 8.14). Mission, satisfaction, and impact comparisons are significant at $p < 0.01$; $p = 0.03$ for the interest comparison.*

*The p-value is a measure of significance. In general, p-values of .05 or less are considered statistically significant.

Members were generally more satisfied with Science Center programs than were non-members and were more heavily influenced by their previous Science Center experiences. Members' ratings for the satisfaction question were significantly higher than those of non-members (3.67, 3.58). Members also gave higher ratings than non-members for the interest question (3.43, 3.12). However, members gave significantly lower ratings than non-members on the mission question (3.71, 3.75). Overall, Science Center programs had a significantly higher impact on members; the average impact score for members (8.52) was significantly higher than the score for non-members (8.38; $p < 0.01$ for all).

On average, tourists gave significantly higher mission and satisfaction ratings than local residents. Tourists gave an average mission rating of 3.80 compared to locals with 3.70; tourists gave an average satisfaction rating of 3.72 compared to 3.57 for locals. Average interest question ratings were higher for locals (3.31) than for tourists (3.04). There was no difference in the average impact score between locals and tourists. Among local respondents, St. Louis County residents had a significantly higher impact score (8.49) than residents of St. Louis City (8.36). The highest impact scores were from outer metro areas of Missouri (8.62) and Illinois (8.59). Residents of Missouri (8.47) and Illinois (8.51) had significantly higher impact scores than residents of other states (8.28).

On average, respondents who indicated they visit the Science Center on a more frequent basis tended to give higher interest ratings. Higher visitation frequencies also correlated to higher impact scores. First-time visitors had an average impact score of 8.27 whereas respondents who visit five or more times a year had an average impact score of 8.62 ($p < 0.01$).

	MISSION	SATISFACTION	INTEREST	IMPACT
Children	3.66	3.57	3.58	8.67
Adults	3.79	3.60	2.96	8.14
Members	3.71	3.67	3.43	8.52
Non-Members	3.75	3.58	3.12	8.52
Tourists	3.80	3.72	3.04	8.42
Locals	3.70	3.57	3.31	8.50

PROGRAM OVERVIEW, BY DEPARTMENT

At the Science Center, programs are divided into five major departments: **Challenger Learning Center-St. Louis, Community Science, Public Programs, School Programs, and Science & Galleries.** Following is an analysis of program offerings based on these categories.

Challenger Learning Center-St. Louis

The Challenger Learning Center, located in Ferguson, MO, provides space education programs for schools, corporations, scouts, community groups, and the general public. At the core of the Center are space simulators, which include a replica "orbiting" space station and a Mission Control center. The program is part of the Challenger Center for Space Science Education, an international, not-for-profit education organization founded in April 1986 by the families of the astronauts tragically lost during the Challenger space shuttle mission. Locally, the Center is supported by a regional partnership of the Saint Louis Science Center, the Ferguson Florissant School District and the Cooperating School Districts. Mission simulations include: *Micronauts*, *Rendezvous with a Comet™*, and *Voyage to Mars™*.

"I liked being responsible for something important."
-Student, *Rendezvous with a Comet* mission

Offerings: 12 distinct programs

Interactions: 11,095

Total hours of engagement with programs: 25,231

Average length of engagement with programs: 2¼ hours

Range of program engagement times: 1½ to 6 hours

Overall ratings:

- Mission: 3.75 (out of 4)
- Satisfaction: 3.55 (out of 4)
- Interest: 3.43 (out of 4)
- Impact: 8.53 (out of 10)



Students from Cross Keys Elementary School work together to navigate the spacecraft during a simulated space mission. (Photo: Ron Bookout, The Boeing Company)

Overall, 86% of the respondents were children and 67% were first time visitors to the Challenger Learning Center. In general, children gave lower mission and satisfaction ratings than adults. Children gave higher interest ratings than adults and had, on average, higher impact scores than adults. The average impact score for children participating in Challenger Learning Center programs was 9.03, compared to 8.27 for adults.

"[The highlight for me was] seeing the kids so engaged in their jobs and mission! Watching them realize and use the skills/ concepts practiced in the pre-mission activities."
-Teacher, *Rendezvous with a Comet* mission

Community Science Department

Community Science programs serve at-risk area teens through the **Youth Exploring Science (YES)** program. **YES** works with underserved teenagers throughout the course of their high school career, providing them with a work-based, inquiry-learning environment focusing on science, mathematics, technology and engineering. **YES** teens are recruited from over 15 community-based organizations that serve low-income families throughout the St. Louis area. **YES** participants gain professional, academic, and real world skills that assist in building self-confidence and personal success. In their teaching initiative, **YES** teens take museum science education into the community and facilitate hands-on science and mathematics activities. Programs include: **City Science**, **Design It!**, **Learning Places**, **Investigation Teens**, and **YES-2-Tech**.

Offerings: 12 distinct programs

Interactions: 11,111

Total hours of engagement with programs: 27,526

Average length of engagement with programs: 2½ hours

Range of program engagement times: 1¼ to 5 hours

Overall Ratings:

- Mission: 3.50 (out of 4)
- Satisfaction: 3.46 (out of 4)
- Interest: 3.32 (out of 4)
- Impact: 8.02 (out of 10)

Overall, 71% of the respondents were children; 41% reported visiting the Science Center five or more times per year. This figure includes participants in the **YES** program who attend programs each Saturday during the school year and daily during the summer months. Given the nature of the programs, 93% of respondents were Missouri residents, with 66% of these residing in St. Louis City.

In general, child respondents gave higher ratings than adults in all categories of Community Science programs. Children also had a higher impact score (8.13) than adults (7.74). There was no difference in average impact scores between residents of the city and the county.

"I liked the volcano because it looked cool and there was carbon dioxide."

-Participant, *City Science*

"Teamwork, we worked as a team and got the job done."

-YES Teen, *Design It!*



YES Teen Carnekia Burnett and YES Supervisor LaKisha McPike show off their DNA necklaces during the 2007 Healthfest. (Photo: Saint Louis Science Center)

Public Programs Department

Programs offered by this department may occur either at the Science Center or off-site and are designed for a range of audiences, including: adults, families, scouts, and home-school groups. Programs include: **Segways**, **Camp-ins**, **Summer Science Blast**, and **Science Cafés**.

Offerings: 18 distinct programs

Interactions: 14,856

Total hours of engagement with programs: 69,840

Average length of engagement with programs: 4¾ hours

Range of program engagement times: ¾ to 17 hours

Overall Ratings:

- Mission: 3.73 (out of 4)
- Satisfaction: 3.59 (out of 4)
- Interest: 3.26 (out of 4)
- Impact: 8.52 (out of 10)

A total of 55% of the respondents were children. 23% of respondents reported living in Illinois, 23% were tourists, and 7% lived in St. Louis City. Eighty percent of those who responded indicated they are not Science Center members. On average, children participating in Public Programs offerings had a higher impact score (8.73) than adults (8.26). Members also had a higher impact score (8.81) than non-members (8.47). There was no difference in impact scores by residence.



While waiting for the next MetroLink train, two teams discuss the clue for their next leg of the **Amazing Challenge**. (Photo: Saint Louis Science Center)



A Segway tour in Forest Park led by Segway trainers Steve and Sue Huber. (Photo: Saint Louis Science Center)

"SUPER STAFF. This was a wonderful opportunity to try something I could never have tried, in a safe environment. Thank you."

-Participant, *Segway*

"[My highlight was] the relaxed atmosphere and the inter-table discussion. That really fueled my appetite for knowledge."

-Participant, *Science Café*

School Programs Department

The School Programs department offers inquiry-based science workshops to school groups visiting the Science Center as well as classroom programs delivered at schools. The department also offers professional development for teachers and opportunities for parents to improve their skills in interacting with their children around science and mathematics learning. Programs include: **Earth Balloon, Family Math & Science, MySci Investigation Station, Storybook Science**, and a variety of teacher professional development workshops. School Programs staff work directly with classroom teachers to ensure the programs fulfill Missouri Grade Level Expectations, Illinois Learning Standards, and individual classroom curricula.

Offerings: 32 distinct programs

Interactions: 23,978 interactions

Total hours of engagement with programs: 41,275

Average length of engagement with programs: 43/4 hours

Range of program engagement times: 1 to 6 hours

Overall Ratings:

- Mission: 3.77 (out of 4)
- Satisfaction: 3.59 (out of 4)
- Interest: 3.50 (out of 4)
- Impact: 8.63 (out of 10)

“Seeing the students totally in to what they were learning and doing!”

- Teacher, *Inquiry into Earth Science*

“The look on my son’s face when we finally got the experiment to work!”

- Parent, *Family Math & Science*



Students create an inclined plane in a simple machines workshop.
(Photo: Saint Louis Science Center)

The majority of the respondents (71%) were children. The majority had also visited the Science Center before, with only 30% reporting that it was their first visit. Only 20% of School Programs participants indicated they were members. 25% noted that they live in Illinois. Illinois residents had a higher impact score (9.03) than Missouri residents (8.76). Children had a higher impact score (8.78) than adults (8.26).

Science & Galleries Department

Programs offered through this department usually take place in the Science Center’s permanent galleries and are generally facilitated by gallery staff. Science & Galleries programs are all tied to the Science Center’s five main content areas: earth science, emerging technologies, life science, physical science, and space science. As appropriate for program content, some programs in this department may be held at off-site locations. Programs include: **Amazing Science Demonstrations, the Discovery Room, DNA In-Depth: Examining the Evidence, FIRST Robotics, LEGO Mindstorms™, Paleotrek** (a paleontology travel program), and **Planetarium experiences**.

Offerings: 25 distinct programs

Interactions: 349,241

Total hours of engagement with programs: 268,870

Average length of engagement with programs: 3/4 hour

Range of program engagement times: 15 minutes to 96 hours*

Overall Ratings:

- Mission: 3.76 (out of 4)
- Satisfaction: 3.65 (out of 4)
- Interest: 3.20 (out of 4)
- Impact: 8.18 (out of 10)

The majority of respondents were adults (72%). Of the total, 22% reported visiting the Science Center five or more times per year and 35% indicated that they are Science Center members. The majority of respondents were locals, with only 25% reporting themselves as tourists. The majority did not live in St. Louis City, with only 11% reporting themselves as city residents.

Children had a higher impact score (8.52) than adults (8.05) and members had a higher impact score (8.57) than non-members (8.11). Local residents had a higher impact score (8.42) than tourists (8.12). There is a positive correlation between visitation frequency and impact score for Science & Galleries programs; the higher the visitation rate, the higher the impact score.

*Over an eight-day period during a Science Center travel program.

“I’ve always wanted to be a geologist and doing this today was cool.

I learned a lot and would want to do it again.”

- Participant, *Fossils around Town*



Life Sciences Gallery Leader Debbie Wudtke demonstrates some properties of plastic in the **Amazing Science Demonstration, “Surprise, It’s Plastic!”**.
(Photo: Saint Louis Science Center)

“This was a well-performed thought-provoking demo. I’m sure we’ll have many conversations as a result

- touched on so many aspects to carry over i.e. my daughter is highly interested in weather so cooling/pressure changes will help solidify her understanding. THX!”

- Participant, Amazing Science Demonstration, “Boiling Hot, Boiling Cold!”

PROGRAM SPOTLIGHT

This section highlights four of the approximately 100 programs offered in 2006-07. The selected programs offer participants prolonged engagement, ranging from one week to multiple years, with science and technology content and experiences. In 2006-2007 we highlight: *Summer Science Blast*, *FIRST Robotics*, *YES-2-Tech*, and *Learning Places*. In subsequent years, other programs will be highlighted.

Program Spotlight: *Summer Science Blast* (Public Programs)

Summer Science Blast consists of a series of weeklong programs, using a day-camp format, to engage youth from elementary to high school in hands-on experiences with science and technology. The program is developed and administered by the Science Center's Public Programs department. In 2007, the program took place from June 11 to August 17 and offered 24 different class options to over 700 enrollees. This marked the fifth year that *Summer Science Blast* offered multiple classes from which participants could choose; previously, one class was offered throughout the entire summer, with variations for different age groups. In that format, participants could only sign up for one week of camp. Currently, participants have the opportunity to sign up for multiple classes and weeks of camp. In 2007, nearly 60% of participants took advantage of this option and participated in more than one class.

Feedback on their experience with the program was collected from both children and parents, with a response rate of 61% for children and 26% for parents. Demographic information was also collected. Of the children whose parents responded and indicated their child's gender, 76% were male and 21% were female. The majority of parents (97%) reported they were from Missouri and 57% reported having a Science Center membership. When asked about previous Science Center visitation, 25% of children reported visiting five or more times in the last year and 24% reported that the 2007 *Blast* program was their first experience with the Science Center.

Of all children responding, 59% said they had not previously participated in *Summer Science Blast*. A higher percentage (73%) of responding parents stated that their child had not previously participated in the program. For those parents indicating prior participation by their child, the average number of years was 2.7.

Children who filled out the feedback form, based on the BERTT format, gave the following average overall ratings for *Summer Science Blast*:

- Mission: 3.58 (out of 4)
- Interest: 3.47 (out of 4)
- Satisfaction: 3.67 (out of 4)
- Impact: 8.44 (out of 10)

Of the 24 classes offered, 21 had sufficient data (return rate greater than 30%) to support analysis. Of those 21 classes, five had an average mission rating of 3.7 or higher and 11 had an average BERTT satisfaction rating of 3.70 or higher. The highest rated class for mission and satisfaction was "What's the Matter", which was offered for first graders. Both the mission and satisfaction ratings for this class were 3.90. A participant in the class commented on what participants learned, writing "a solid is something that sticks together a liquid is something that follows and a gas you cannot see."

The class with the highest overall average impact score was "Robots, Robots, & More Robots" with a score of 9.26. Overall, when children were asked what they liked best, many comments centered on doing things and getting to participate in an authentic experience:

- "I liked digging up dinosaur bones because it made me feel like a real paleontologist." ("I Can Dig It", Grades 4-5)
- "What I liked best was flying in a real plane because it was a new learning thing and it was exciting." ("Spaceships, Jetpacks, and Airplanes", Grades 7-12)

Eighty-two percent of children stated they learned something directly related to the content of the program and only 2% of children said they thought their class was boring and/or that they did not learn anything. Participant comments included:

- "I learned how the size of the gears affects the speed or torque." ("Robots, Robots, & More Robots", Grades 7-8)
- "That if our brains were not wrinkled, they would not fit in our skull." ("Abracadabra", Grades 2-3)
- "I learned that if you don't know if some thing you found is part of a bone or a rock you can put it up to your tung [tongue] and pull it away and if it sticks it's a bone." ("I Can Dig It", Grades 4-5)

One participant in "Real Robotics" (Grade 6), who received a scholarship to participate, wrote a letter to the Science Center about his experience. He writes,

"I think this program was much more fun and beneficial than I expected... At first, I thought this would be boring, because I studied Robotics in school... Because our school couldn't afford kits and tools, we just learned about the parts of the robot. And it was not fun. But this summer camp gave me a fabulous chance to build a robot and control it. We also used computers to make our own programs... I am 95% sure that you would have enjoyed it if you took the camp. I desire to go to "Real Robotics" summer camp next year again. REALLY!!!"

This participant's enthusiasm and interest in further pursuing robotics speaks to the program's effectiveness in engaging participants and providing an experience not easily obtained elsewhere.

In describing what they liked best about the program, 40% of responding parents related a specific aspect of the experience, 22% gave a general, positive comment, and 18% said that their child learned something. Comments included:

- *“He enjoyed his experience and was thrilled that his team won the robotics competition. Also, he talked to the other kids instead of sitting in a corner and being shy.”* (Parent of 7th grader, “Robots, Robots, & More Robots”)
- *“Our son has been talking to other family members and friends about the importance of recycling and how to determine if something is recyclable.”* (Parent of 1st grader, “Trash to Treasure”)

In relating how the program impacted their child, 33% of parents gave a general, positive response; 23% said their child experienced personal development or growth; and 16% said their child learned something. Representative comments include:

- *“She is showing more interest in science and learning about weather, which is great for her knowledge base and her and her brother, who also took the class, have more in common now!”* (Parent of 3rd grader, “Master of Disaster”)
- *“Prior to her showing interest in this camp I didn’t realize she was considering becoming a pilot. This was an incredible opportunity for her and enabled her to learn and experience a lot about aviation in a short period of time. Maybe she will decide to pursue aviation as a career or hobby.”* (Parent of 9th grader, “Spaceships, Jetpacks, and Airplanes”)



Three participants in Spaceships, Jetpacks, and Airplanes and their camp counselor (kneeling) pose proudly in front of a Piper Warrior II aircraft while their flight instructor reviews the pre-flight checklist. Over the next few hours, each camper will pilot a similar small aircraft for the first time. (Photo: Saint Louis Science Center)

In describing opportunities for improvement, some parents commented on the location of the program; some sessions were held at Saint Louis University High and others were at Babler State Park. Parents whose children attended the camp at Babler indicated that they would prefer to be at the Science Center or closer to it.

In general, parents and children seemed to appreciate the opportunity **Summer Science Blast** provided to engage with specific science and technology content in a more in depth manner, based on the participant’s particular interest.

Program Spotlight: **FIRST Robotics (Science & Galleries)**

FIRST (For Inspiration and Recognition of Science and Technology) was founded in 1989 by Dean Kamen, President of DEKA Research & Development Corporation, in response to a serious national situation: too few young people were interested in pursuing the intellectual and career opportunities offered by science, technology, and engineering.

To address this issue, **FIRST** designed a series of innovative robotics competitions. **FIRST Robotics Competition**, **FIRST LEGO League**, and **FIRST Tech Challenge** build science and technology skills and interests, as well as self-confidence, leadership, and life skills. Central to the **FIRST** mission is the **FIRST Robotics Competition** in which teams work with mentors from science and engineering fields to solve a design challenge in robotics. To build their competition robot, each team has six weeks to work, a standard parts kit, and a common set of rules. With the talents and resources of young people, parents, schools, and communities, teams build their robots and enter them in regional competitions. Teams are judged on the excellence of their design, technology, sportsmanship, and commitment to **FIRST**. **FIRST** competitions combine the excitement of high-school sports with intellectual engagement for what the organization calls the “hardest fun ever.”

The Saint Louis Science Center has been the major sponsor and educational partner for **FIRST** in the St. Louis area since 2002. With an all-volunteer St. Louis **FIRST** Planning Committee, the Science Center supports three competitions each year: **FIRST Robotics Competition** in March; **FIRST LEGO League** (ages 9-13) and **FIRST Tech Challenge** (ages 13-18), as well as team development activities throughout the year. The Science Center also hosted the 2007 **FIRST Robotics** kickoff event, which marked the beginning of the robotics season, and a **FIRST Robotics** celebration party to conclude a successful 2007 robotics season.

The 2007 St. Louis Regional Competition fielded 45 teams, including 16 teams from the St. Louis area. One adult volunteer spoke to the growing interest in **FIRST**, “Our team has doubled in size this year and our entire district has begun to support the program.” Internationally, the 2007 **FIRST Robotics Competition** was comprised of 1,307 teams from seven countries, incorporating over 32,500 high-school students.

During the *FIRST Robotics* celebration, both student participants and adult volunteers provided feedback on their overall experience in the 2007 *FIRST Robotics* season. They gave the following average ratings in response to the Science Center's program evaluation system (BERTT):

- Mission: 3.84 (out of 4)
- Interest: 3.18 (out of 4)
- Satisfaction: 3.88 (out of 4)
- Impact: 8.20 (out of 10)

In comparison to other extracurricular activities, the majority of student respondents found *FIRST* more influential in their lives than other activities. Of those responding, 39% claimed it was "much more influential" and 39% stated it was "somewhat more influential". One student remarked, "It has given me a very strong passion to learn more about engineering and design." An adult volunteer stated, "[The students] are learning to define objectives, and do cost/benefit of possible features (can't do everything well) and to think in mechanical terms." In addition, 33% of student respondents cited the process of learning as the highlight of their experience in *FIRST*.

Through multiple evaluation studies, *FIRST* has proven to have a strong influence, especially on students' ability to work as a team and on their future career goals. As one adult volunteer noted, "These kids bonded as a team. They worked amazingly well together, and many students plan on science as a career." During the Science Center's evaluation, the student participants were asked to assess the amount of impact their involvement in *FIRST* had in three specific areas: stimulating an interest in a science and/or technology career, building an understanding of the value of teamwork, and creating a desire to mentor younger students.

Career Choice

All respondents either agreed (54%) or strongly agreed (46%) that *FIRST* impacted their interest in a future science or technology career. One student remarked, "FIRST got me addicted to building things, and played a large role in my career choice. Yay!" A parent of a student participant stated, "My son's really started to focus on his future." A broader evaluation of *FIRST* programs was conducted by Brandeis University's Center for Youth and Communities. This study included a report from the 2006-2007 Saint Louis Regional *FIRST Tech Challenge* (then called the *FIRST Vex Challenge*). This robotics program offers students a traditional *FIRST* challenge with an intermediate level, moderately priced robotics kit. Participants were also asked about the impact of *FIRST* on their future career plans. Of the total respondents, 61% strongly agreed and 25% agreed that, as a result of participating in the *FIRST VEX Challenge*, they were more interested in a career that incorporated science and engineering.

Value of Teamwork

Similar to the influence of *FIRST* on students' career choices, all respondents either agreed (54%) or strongly agreed (46%) that *FIRST* helped them understand the value of teamwork. Brandeis' study of the *FIRST Tech Challenge* also found that 94% of respondents agreed and 67% of those strongly agreed that their participation in the *FIRST Tech Challenge* helped them understand the value of working on a team. An adult volunteer observed that for his students "learn[ing] to work as a team, under deadlines, was a source of pride and identity." Furthermore, 25% of respondents from the Science Center study specifically cited personal interactions with fellow teammates as the highlight of their experience in *FIRST*.

Future Role as Mentor

In response to the goal of developing mentorship interests, 62% of respondents agreed and 15% strongly agreed that *FIRST* made them want to help younger students. One student specifically stated, "[FIRST had] a big impact over my life, it makes me want to join as a mentor next year."

Overall, *FIRST* offers an exceptional opportunity for high school students to gain interest and experience in science and technology fields, to build interpersonal and leadership skills, and to adopt a community-oriented mindset.



Members of the River City Robots team compete at the St. Louis Regional *FIRST* Robotics Competition. (Photo: Hans Giersberg)

Program Spotlight: *YES-2-Tech* (Community Science Department)

YES-2-Tech is funded by a three-year grant from the National Science Foundation (NSF) providing *Youth Exploring Science (YES)* teens meaningful opportunities to work closely with a wide array of technology. *YES* is a structured, work-based program launching fourteen-year-olds on a four-year journey of self-discovery through science. *YES* provides teens opportunities to explore scientific concepts through inquiry-based experiences and to then teach younger audiences. The *YES* program seeks to offer a transitional experience for youth into higher education and the professional work world, particularly in the area of science, technology, engineering, and math (STEM).

During Year One, *YES-2-Tech* participants used engineering principles and computer software to design and construct low-cost greenhouses to be used by community partners. As part of the greenhouse initiative, teens participated in two rounds of the systematic engineering practice of “design-build-test”, authentic practices used by professional engineers.

Additionally, they explored how to grow edible plants in St. Louis and shared their processes of innovation and discovery with community partners. *YES-2-Tech* teens also created podcasts and a website to describe their work. Teens also developed and delivered science activities related to structures and greenhouse science to younger children at community partner sites.

During the 2006-07 program year, 23 teens participated in *YES-2-Tech* and delivered programs to approximately 120 children. Teen participants were given the opportunity to rate their experience through the Science Center’s program evaluation system (BERTT) and gave the following average ratings in response to these questions:

- Mission: 3.20 (out of 4)
- Interest: 3.19 (out of 4)
- Satisfaction: 3.23 (out of 4)
- Impact: 7.44 (out of 10)

An external evaluator, Dr. Joseph L. Polman, Assistant Professor of Educational Technology, University of Missouri – St. Louis, conducted qualitative research on teens’ experiences in the program. Polman’s methods included: participant observation, analysis of selected audio and video recordings, interviews, and analysis of artifacts created by students. Following are findings from Polman’s research.

Growth in Process Skills and Science Content Knowledge

Designing and refining the greenhouses involved teens in solving a large number of science and engineering problems that arose in the course of planning, construction, maintenance, and dissemination. Examples of problem-solving included: figuring out a means to prevent wood rot in the geodesic dome greenhouse design, producing photographs to convey the construction process, and figuring out how to interpret the greenhouse effect and other scientific phenomena to young children.

Teens also went through an iterative design process in creating an explanatory website about constructing the greenhouse, similar to the iterative design process they used to complete the greenhouse structure. In developing the website, teens had to gain proficiency in a number of aspects of information technology. Technology skills were also honed in creating video podcasts to describe their design process.

Through observations, interviews, and analysis of artifacts created by teens, Polman found evidence that teens increased their understanding of a variety of scientific phenomena. These content areas included: the greenhouse effect, evaporation, photosynthesis and plant growth, ecosystems, food cycles, the water cycle, and seasonal change. Teens’ learning of these scientific concepts was greatly facilitated by their teaching of these concepts, through activities they helped develop, to children in the partner community groups.

YES-2-Tech as Apprenticeship

One aspect of Polman’s research examined the nature of the program as a unique form of apprenticeship, aimed at fostering positive, professional identities among participants. Teens were gradually given manageable responsibilities, increasing their likelihood of success. Supervisors modeled how to lead science activities and then coached teens as they practiced leading the activities. When teens began making presentations to community groups, instructors helped them make adjustments and solve problems that arose. As teens took on more responsibilities, they transitioned into being knowledgeable leaders in the program and began to see themselves as having expertise. Teens also learned from each other, with older teens helping to mentor and support younger teens.

Some teens found learning new roles and skills challenging. The *YES-2-Tech* program seeks to turn challenges with participants into opportunities for engaging more deeply with the teens. Instructors dealt with problem behaviors by talking with teens directly and in private, as opposed to in front of the larger group. By talking to teens privately, instructors helped prevent teens from being seen negatively by their peer group. Teens noted that they felt the instructors were invested in them. One teen described this approach as the instructors communicating to teens, “...no matter what you do, we’re still gonna be here to help work with you.”

YES-2-Tech Teens as Leaders

Teens, particularly those who had been in the program longer, were observed to take on more leadership roles. This was demonstrated through the manner in which they initiated action and spoke comfortably with visitors. In interviews, older teens often indicated they were shy and quiet when they started the program, but were now able to speak in front of strangers and large audiences. Teens’ progress at presenting to strangers was evident through less mumbling, a higher quality of preparation of materials, and speaking more extensively

in presentations as they spent more time in the program. Taking leadership, initiative, and speaking effectively in front of and with strangers were practices teens learned and developed in the course of their apprenticeship in the **YES-2-Tech** program.

One teen described how **YES-2-Tech** helped improve his ability to work with diverse groups of people, saying, “it was just like expanding like, the group of people that I was able to communicate with.” Staff made efforts to help prepare teens to work with elderly people and people with disabilities. At first, some teens hesitated to converse in small groups with the visitors, but soon they were assisting people individually in exploring and creating things, as they routinely did with all visiting groups.

Polman also observed that the **YES-2-Tech** staff solicited input from the teens about how the program should operate. This gave teens a sense of agency and the experience of having adults take their concerns seriously. Polman noted that this encouraged a future outlook that supports teens in expecting they will continue to progress and go to college.



A YES teen works with a St. James Community Center participant on a re-engineered low-cost geodesic dome greenhouse. (Photo: Saint Louis Science Center)

Increasing Interest in Science Careers

Through the **YES-2-Tech** program, teens have opportunities to interact with a number of scientists and engineers. This exposure seeks to foster interest in STEM careers and a more positive attitude toward STEM in general. From surveys and observations conducted during Year 3, it is clear the program provided new and positive associations with STEM for teens and also influenced teens positively toward STEM career aspirations.

Visiting scientists and engineers also passed along information helpful to succeeding in the professional world. One female speaker modeled an effective method of presenting a power-point presentation. Teens were observed using these techniques in their subsequent presentations.

A female teen with an interest in chemistry approached this female engineer to discuss the possibility of working in chemical engineering. From this conversation, the teen began considering engineering as a possible career path.

Experiences in **YES-2-Tech** built teens’ confidence, allowing them to face future challenges with a positive self-image. Consequently, participation in **YES-2-Tech** can position teens for success in their academic and professional lives beyond the program.

Program Spotlight: Teenage Designers of Learning Places (Community Science Department)

Initiated in September 2005, the **Learning Places** project results from a four-year grant awarded by the National Science Foundation (NSF) to the Saint Louis Science Center in partnership with the Science Museum of Minnesota. Other partners include community organizations that provide after-school programs and the City College of New York, providing professional development support. **Learning Places** involves area teenagers in creating engaging and innovative activities and environments for teaching science, technology, engineering, and math (STEM) content and processes to younger children. **Learning Places** is a component of the **YES** program, the Science Center’s four-year, work-based program for area teens.

The collaboration seeks to be a model for mobilizing community resources in support of STEM learning and to have the following impacts:

- Promote learning of STEM concepts and processes by adolescents and children through innovative, hands-on STEM learning experiences in informal settings.
- Engage staff and administrators of science museums and after-school centers in support of STEM education in low-income, urban communities.
- Develop and disseminate a model for collaborative design and implementation of STEM learning opportunities by university faculty, science centers, community centers, youth organizations, and teenagers.

During 2006-07, the second year of the project, 20 teens participated in **Learning Places** and delivered programs to over 800 three- to twelve-year-olds. St. Louis teens participated in half-day training sessions on Saturdays during the school year and created spaces and led activities for children at five after-school program sites during the summer. These teens developed water activities and designed water tables for the after-school centers and conducted activities at the Science Center’s Taylor Community Science Resource Center. An ongoing evaluation is being conducted by external evaluator Dr. Christine Klein, using both qualitative and quantitative methods to capture participants’ experiences and assess the program’s effectiveness in achieving the desired impacts.

Project Management

During the first year of the project, the evaluation process identified key issues related to successful management of **Learning Places**. One issue was the need for staff at all levels to be able to think both theoretically and practically as they develop and implement the program. Staff working on the national aspects of the program tended to focus more on theoretical considerations, while staff working directly with teens and partners had a more practical focus. Both perspectives

were identified as valid and the recommendation was made to communicate, consider, and integrate both in order to strengthen the project. This integration is well underway as the project begins its third year.

During the first two years of the project, clearly communicating the roles of everyone in the project, as well as the importance of communication in general were identified as key to the project's success. In interviews and journal entries, participating teens noted the importance of communication skills to their work. One teen said that the project had already, *"taught me how to communicate with kids more than I really thought I would."* Another teen, writing about personal goals in a journal, noted *"To stop from being shy. I will talk more about the project. When we do group project I will be more a part of the presentation and maybe do the speaking part."*



Children at the Christian Service Center, Gateway Homeless Services, engage with a water table experience created by *Learning Places* teens. (Photo: Saint Louis Science Center)

Impact on Teens and Children

During the first two years of the project, there were no conclusive findings relating to how *Learning Places* was achieving its goal of deepening understanding of STEM content among children and teens. From conducting interviews, reading blogs, and making observations, it was clear the teens were developing insights into learning and teaching. The teens were able to articulate what made a good learning activity and, when their individual ideas were combined, they matched those of current educational research. Teens were asked to explain in interviews what made an activity fun as compared to what made an activity boring. Teens described a fun activity as being hands-on, with lots of materials. Conversely, a teen described a boring activity as *"doing things like how they're supposed to be done instead of experimenting with different things."*

The data also shows that teens have developed their problem-solving and design skills and have indicated a willingness and ability to approach problems analytically. Further, many teens in the project are considering careers in STEM areas, although most reported having had those career goals prior to joining the program. Evaluation will continue to clarify project goals for teens and determine how to best assess these goals.

It is hoped that findings from this project will support informal science education beyond this project. Continuing evaluation of *Learning Places* is focusing on how roles are being defined as well as how communication is taking place among all the partners. Evaluation is also examining STEM content understanding by children, teens, and staff as well as training and support of staff in STEM content.

LOOKING TO THE FUTURE

As evidenced from the activities and experiences described in this report, the Saint Louis Science Center's educational programs have tangible and positive impacts throughout our community. We are engaging young people, families, teachers, adults, and our general public in asking questions, following their interests, and becoming lifelong learners in science and technology.

In the coming years, we will continue to create programs that spark curiosity, offer engaging experiences, and provide accessible opportunities for our increasingly diverse audience. We will be the "go to" place for science; a place where people can learn about and discuss current scientific developments and consider what these developments mean to their lives. Our programs will offer authentic experiences with science and opportunities to interact with scientists.

We recognize that science literacy is necessary for civic participation. We will be a guide to the wealth of science and technology resources in our community, raise awareness of the importance of science and technology in our region, and provide a forum for discussing key issues that shape our future. Inherent in all our initiatives is an understanding that quality, well-designed science experiences are fun, interesting, and captivating in their own right.

In 2008, we continue to open minds to science and will embark on a path that will lead the Science Center to become the Center for Science in our community.

APPENDIX

Saint Louis Science Center Education, Exhibits & Programs Staff As of November 30, 2007

Krystal Aikens*	Brandon Byrd	Marquis Dotson	Kevin Griffin*	Meredith Jones	Taylor Miller*	Robert Rinehart*	John Torrey
Marlow Allen, Jr.*	Cambreana Byrd*	Pili Dressel	Daisionara Gurley*	Myesha Jones*	Aaprara Mills*	David Ritchey	Robert Treece
Chris Allen	David Callahan	Terrence Dwyer	Eric Gustafson	William Kelly	Aariel Mills*	Andrew Robbins	Laqwana Trice*
Saxon Allen*	Joshua Campbell*	Trish Edwards	Andrew Haines*	Steve Kessel	Christina Monroe*	Timothy Roberson	Jasmine Tripp*
Joel Anderson	Lisa Carrico	Martha Elias*	Tracy Hale	Kathryn Kiel	Fredrick Monroe*	Gregory Robertson*	Mei-Ling Tung
Matthew Anderson*	Jessica Castiglioni	Olef Elias	Dave Hall, Jr.*	Matt Kindt	Carl Moore, Jr.*	Jalis Robinson*	Kiontey Turner*
Edwin Asencio*	Alicia Castillo*	Exzavean Ellison*	Brian Hamilton*	Darrion King*	Jalen Moore*	Natasha Rogers*	Jazmine Tutwiler*
Cherelle Assee*	Adam Catchings*	Antonio Embry*	Kyle Hardin*	Betsy King	Susan Morris	Christine Roman	Nao JacQuelynn Ueda
Jamiah Austin*	Christopher Cella	Daphne Emrick*	Skyler Harmann	Robert King	Sam Morrison	Krystal Salamon	Carol Valenta
Jasmine Bailey*	Jessi Cerutti	Cindy Encarnacion	Natalie Harrell*	Orville Kirk	Koran Muhammad*	John Schmitt	Jonathan Verheyen
Rena Bailey	Todd Chavers*	Patrice Espeut*	Nichole Harrell*	Walter Koester	Timothy Mulhall	Michael Schoenewies	Ashley Verweyst
Thomas Bailey*	Jenny Cimino	Jamaal Fisher*	Kristina Harris*	Tamara Korina	Cynthia Kramer	Sarah Schoenlaub	Brandon Wade
Jon Baker	Devin Clark*	Jason Fivecoat	Jennifer Heim	Frank Kusiak	Najma Nasiruddin*	Erin Scott*	Najwa Wakil*
Shannon Baker	Lavelle Clark*	Gemecia Fleming*	Lea Heintz	John Lakey	Suzanne Nauert	Joe Seidler	Ashley Wallace
Frank Banaszek	Sharniqua Clark*	Miesha Fleming*	Charles Heuvelman	Jasmine Lester*	Colin Nelson*	Antonio Shepard*	Margie Walsh
Jarred Banks*	Melva Claxton	Aaron Ford*	Quion Hicks*	Kenisha Lewis*	Darlene Norfleet	Nicholas Simms*	Suzanne Walton
Matthew Bartlett	Jacobie Collard*	Jo-Ellen Forrest	Andrea' Hollins*	Rachel Ligon*	Meesa Olah	Dennis Smith	Jordyn Warts*
Thomas Becker	Kimberly Collins-Bey*	David Francis	Garie Holman	Adrian Lindsey*	Richard Osborn	Frieda Smith	Kevin Washington*
Jennie Bellinger	Jason Cook	Dalila Franklin*	Michael Houska	Lauren Lipsey*	Bryan Owens*	Ian Smith	Danny Watson*
Kyshae Biggs*	Darnell Cooper*	Jason Franklin*	Jasmine Howard*	Christina Lovett*	Ashley Palmer*	Izel Smith*	Ruth Watt
Tia Black	Trenell Cooper*	Paul Freiling	Robyn Hudson*	Chris Lucas	Taylor Payne	Nina Smith	Briante Wells*
Kevin Boyd, Jr.*	Jean Corse	Melinda Frillman	Susan Hull	Felix Lui	Niki Penson*	Briana Sowell*	Gloria White
Mark Bradley	Courtney Cotton*	Tasmyn Scarl Front	Tyler Hunt	Francis Mack	Robert Perlman	Tonisha Spencer*	Jevion White
Courtney Brooks*	Jamar Crittenden*	Johann Galikin	Layne Ibel	Nicholas Mackey*	Libby Peters	Blake Staten*	Silvester Wilkes*
Patricia Brooks	Tanya Cross	Heather Gallagher	Carolyn Ikpeama	Mike Malolepszy	Alonzo Pettiford, Jr.*	Juanita Staten	Antonio Williams*
Ebony Brothers*	Chelsea Culberson*	Jazmin Garrett*	Elisa Israel	Darrah Mannix	Rachael Phillips	Ariel Stavri*	Brett Williams
Matia Brothers*	Dwight Curry	Ron Giesler	Glenn Jackson*	Gregg Maryniak	Diane Pilla	Steve Steadman	Diamond Williams*
Jasmine Brown*	Ramone Curry*	Precious Gleason*	Gywanna Jackson	Travis Mayes*	Anjanea Pointer*	Erin Steinert	Erik Williams
Jenny Brown	Lance Cutter	Ronald Goldfeder	Lawanda Jackson*	Tiara McCarter	Justin Polacek	Kerry Stevison	Patrick Williams*
Taneika Brown*	Blake Daily*	Lajuanya Goodrich*	Delle Jackson	Jasmaine McCurry*	Pierica Polk*	Danielle Stewart	Travelle Williams*
Elmise Bryant	De'andre Davis*	Autumn Gordon*	Dominic Jarrett*	Kellie McCurry*	Barb Pollman	Mary Stewart	Staci Willis
Jimmy Burchfield*	De'marco Davis*	Revell Graham*	Breia Jefferson*	Andrew McGarrahan	Robert Powell	Mehyaisha Sumrall*	Al Wiman
Carnekia Burnett*	Lacey Dean	Kendall Granger, Jr.*	Shanea Johnson*	Tiera McGowan*	Jessica Preston*	Markietta Tate*	Scott Winstead
Ogie Burrow	Rachel Debold	Cynthia Graville-Smith	Airea Jones*	Vincent McKinney*	Billy Preston	Kia Taylor*	Jasmin Woods*
Korry Busch*	Hugo Delgado*	Jessica Gregory	LaRon Jones*	Ann McMahan	Leslie Ramey*	Devonne Theard*	Debbie Wudtke
				LaKisha McPike	Desiree Redus*	Priscilla Thomas	Jeannie Young
				Thomas Michalak	Sean Redus*	Marwin Thompson*	Randell Young*
				Missy Miller	Keefe Reuther	Rebecca Thorn	Randle Young*
				Diane Miller	Desmond Riley*	Amanda Tinnin	Nicholas Yount
				Lamar Miller*	Siinya Riley-Dulaney	Heather Tisdal	

*Youth Exploring Science (YES) Teen

SOURCES

Falk, J. & Dierking, L. 2000. *Learning from Museums: Visitor Experiences and the Making of Meaning*. Walnut Creek, CA: Altamira Press.

Klein, C. 2006. Teenage Designers of Learning Places for Children: Creating After-School Environments for STEM Education, Summary of Findings from Year 1.

Klein, C. 2007. Teenage Designers of Learning Places for Children: Creating After-School Environments for STEM Education. Second Annual Formative Evaluation Report.

Klein, C. 2007. Teenage Designers of Learning Places for Children: Creating After-School Environments for STEM Education. Evaluation Report to the Community.

Polman, J. L. 2007. YES-2-Tech: Youth Exploring Science to Technology Year 3 Evaluation Report, September 2006 - August 2007.

Polman, J. L., and Miller, D. (in review). 2007. Changing stories: Trajectories of identification in a borderlands community of practice.

Polman, J. L., and Miller, D. (in review). 2007. Sociocognitive apprenticeship: Mediating practices and identities.

NOTES

NOTES



Printed with soy-based ink on
30% post-consumer recycled content.



Saint Louis Science Center, 5050 Oakland Avenue, St. Louis, MO 63110