

Introduction

Just as industrialization defined the early 19th century, and the “information age” was ushered in during the 20th century, Science, Technology, Engineering and Math (STEM) will be the defining feature of economic developments in the 21st century and beyond. Throughout the Westernized world, growth industries are increasingly reliant upon experts in the STEM disciplines, yet the opportunities to take advantage of academic and vocational preparation for careers or entrepreneurship in STEM are often unequally distributed. African-American youth, particularly those from low-income communities, are often unaware of the opportunities.

A group of volunteers, led by the Sankofa Development Corporation organized The Science, Technology, Engineering and Math Conference and Expo (STEMcx) to address this gap, and stimulate an interest in the field among African American youth in Baltimore. Without the contributions of the event sponsors the event could not have been held. **Those sponsors are Northrop Grumman, Baltimore Gas and Electric, MECU of Baltimore, local members of the Pan Hellenic Council, T. Rowe Price, Johns Hopkins Center for Talented Youth, The New Psalmist Baptist Church and the Pikesville Hilton Hotel.**

The event, which brought together youth, parents, teachers and STEM professionals, was designed to highlight the importance of education in STEM and how academic achievement in STEM subjects can translate into rewarding career opportunities and exciting real-life applications. The event ran from 8:00 AM to 6:00 PM and students were served breakfast and lunch. Each student received an event tee-shirt and an event bag which included several books and STEM related paraphernalia donated by various groups such as The National Academy of Science and the National Association of Math Teachers.



While STEMcx was open to all students in middle and high school, special emphasis was placed on organizing events that would be appealing to girls in an attempt to address the gender gap in performance in STEM subjects in secondary education as well as in college and graduate school. The STEMcx organizers hoped to expose all students to ideas and career opportunities that would interest them, and to introduce them to men and women in the STEM professions that they could look to as role models as they plan for college and careers.

Overview of STEMcx

The conference was organized into four key segments, which were designed to engage students, parents and teachers in the STEMcx experience using different techniques. After an introduction from Baltimore Mayor Stephanie Rawlings Blake as well as sponsor pastor Dr. Walter Scott Thomas, the conference began with a motivational keynote address by Dr. Freeman A. Hrabowski, III, President of the University of Maryland Baltimore County and nationally known STEM advocate. Dr. Hrabowski, who is a prominent African American mathematician, used personal anecdotes to motivate the students to not only get as much out of STEMcx as they could, but to stay connected to the professionals they would meet, and to make a commitment to pursuing a STEM career.

The second segment of STEMcx was organized around ten breakout sessions that were designed to encourage students to view the STEM disciplines in a new and exciting way. Each student pre-registered for two breakout sessions, which were each 90 minutes in duration. The sessions were designed to be very hands-on—offering the

chance for students to create, innovate, collaborate and explore a variety of fascinating (and fun) experiences related to STEM careers.



The third segment of the conference was a "STEM Fair and Expo" which was organized much like a career fair. Presenters from local colleges and universities set up tables to allow students, parents and teachers to learn about educational opportunities available locally. Employers representing STEM professions were there to discuss internship, training and employment opportunities.



The final session of the day was a discussion panel on opportunities in the health sector, hosted by Kellye Lynn, former Health Reporter for WJZ-TV, Baltimore. The panel consisting of over 20 health care professionals from lab technicians to surgeons, focused on the breadth of careers available in the healthcare industry, and offered students an opportunity to engage in a question-and-answer session.

The day also included a parent session, hosted by Tyrone Taborn, CEO of Career Communications Group, three teacher workshops and a book signing for teachers by Cr. Christopher Emdin, author of *Urban*

Science Education for the Hip-hop Generation.

STEMcx Student Assessment

The evaluation of STEMcx was designed to assess what students learned and valued most about the conference and expo. The organizers of STEMcx were most interested in learning what worked well and what could be improved from the point of view of the students in attendance. Therefore the data collection and analysis focused on student respondents, despite that fact that there were sessions at the conference specifically targeted to teacher and parents.

We sought to first establish students' pre-conference understanding of the field, and their attitudes about pursuing STEM disciplines and career opportunities. After the conference we were most interested in assessing the students' immediate impressions of their satisfaction with conference and advice on how it may be improved in the years to come. The tools utilized in this evaluation were easily administered at low-cost to the STEMcx organizers, and presented little to no burden on the students themselves.

Prior to the conference, we asked all registered students to complete an online survey to assess:

- General demographic information
- Their understanding of the STEM concept
- Their attitudes about exploring STEM disciplines in secondary school and college
- Their attitudes about STEM careers
- Their attitudes about gender differences or gaps in the STEM professions

After the conference, each student was invited to complete a student satisfaction survey, which was designed to get their candid feedback about their experience of the event. In addition to the surveys, we gathered more detailed feedback from a focus group comprised of 10 students who were representative of the overall population in terms of age and gender breakdown.

This brief evaluation report will describe the STEMcx activities and attendees; report on student perceptions of STEM academic disciplines and career opportunities prior to



the event; and report on student perceptions of STEMcx, with a focus on:

- What excited the students most,
- What students learned, and
- What improvements students suggest for upcoming STEMcx conferences.

Description of the Attendees

The response to the invitation to participate in STEMcx was consistent with what program planners had expected: due to aggressive outreach by STEMcx organizers, enrollment reached capacity prior to the day of the event. Over 150 elementary, middle and high schools in Baltimore City and the surrounding counties were represented among conference attendees. Students came from public, private, parochial and magnet schools, with a number coming from high schools that specialize in STEM (such as Baltimore Polytechnic Institute, Vivian T. Thomas Medical Arts Academy, Western School of Technology, the MATHS Charter School and the Bluford Drew Jemison STEM Academy).

In total, 359 students registered for the event. Of the registered participants, 197 (54%) were girls and 162 (45%) were boys. The age range in the group was fairly mixed: 42.3% of students were 11-13 years old; 41.5% were 14-16 years old; and 12.1% of students were 17-19 years old.

Although the pre-conference survey was offered to all the registered students, only 143 students (39.8%) responded. While this is a respectable response rate for an online survey, we must not assume that the responses of these students are reflective of the entire population of students who attended the conference. Therefore, the results of the pre-conference survey can be

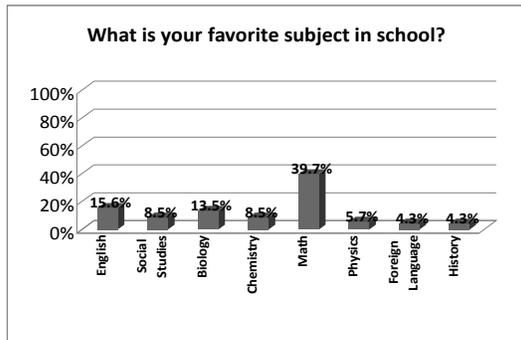
used to generate a general impression of student attitudes, but should not be understood to reflect all STEMcx participants' understanding of STEM or interest in pursuing STEM careers. It is likely that the most motivated or engaged students were those who responded to the online survey (or that the respondents were those who have internet-access in their homes), so the results are likely to be positively skewed. In follow-up evaluations, efforts will be made to incentive all registered students to complete the online pre-conference survey.



Results from the Pre-Conference Survey

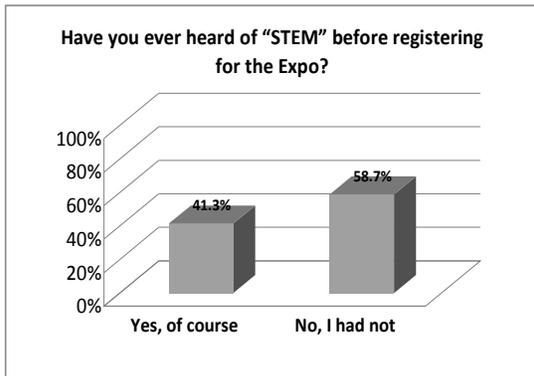
A number of questions on the survey were designed to assess students' pre-conference awareness of and interest in STEM. We were interested in knowing if the conference attracted students who were predisposed to be interested in an event about science and technology, or if the organizers had successfully reached out to a broad group of students, including those who may not have had a strong interest in math and science prior to attending STEMcx. To assess students' levels of STEM awareness, we posed two types of questions. First, we asked students about their favorite subject in school. As expected, the majority of students (67%) reported that science or math classes were their favorite subjects, while roughly a third (32.7%) favored their humanities classes (English, social studies, history and foreign language).

Figure 1:



Students were also asked if they heard the term “STEM” prior to being invited to the conference, and as Figure 2 illustrates, the majority had not. This finding suggests that organizers did a good job of reaching out to students who have had limited exposure to the field prior to the Expo, even among students who prefer math and science classes at school.

Figure 2:



We also sought to assess the level of self-confidence and “STEM-confidence” of the conference attendees by asking them if they could see themselves as professionals in the field in the future. We were encouraged by the responses to these questions:

- 94% of students percent stated that they are “smart enough to become a scientist or engineer” (Figure 3)
- 79% of students reported that they could see themselves in a STEM-related career in the future. (Figure 4.)

Figure 3:

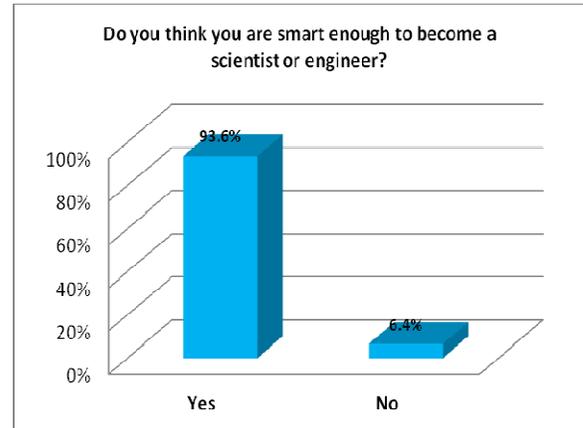
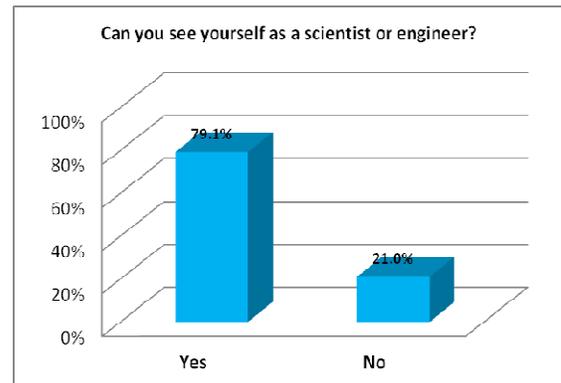


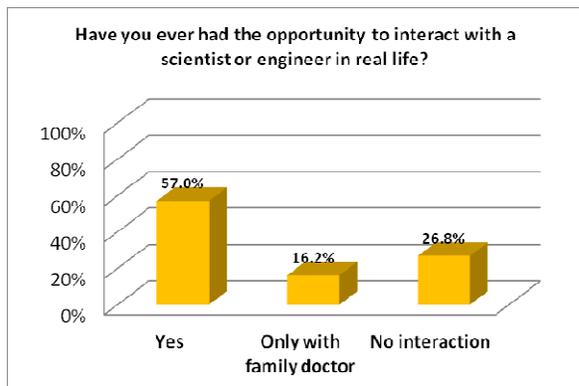
Figure 4:



We were very interested in understanding if girls and boys viewed STEM disciplines and careers differently prior to attending the conference, and specifically, whether they would respond differently to questions about gender differences in the field. When asked about competency in math and science, 23% percent of girls reported that science and math come to boys “naturally” compared to 38% percent of boys. In a related question, we asked about whether it is more difficult for girls to go into a career in STEM, and found that that 32% of girls and 19% of boys agreed that it is. These results suggest that while only a minority of youth hold on to stereotypical notions of gender differences about competency in the STEM field, teachers and parents should be alerted to the need to continue to conduct outreach to girls (and boys) that portrays STEM as a field that is open to women, and one in which women excel.

Finally, we were interested in assessing whether STEMcx would indeed be the first time that students had the opportunity to interact with STEM professionals (other than their family doctors.) As depicted in Figure 5, the vast majority (57%) of the surveyed students had interacted with a scientist or engineer prior to the Expo, but a significant number had not. This confirms the importance of providing a welcoming environment for students to meet and engage in conversation with STEM professionals, particularly professionals of color.

Figure 5:



Student Assessment of the STEMcx Conference – Survey Results

Student satisfaction surveys were distributed and collected on-site during the final segment of the conference¹. In addition to the student satisfaction survey, a group of 10 students participated in a 90-minute focus group immediately following the health panel.

¹ Disappointingly, the response rate to the student satisfaction survey was low: only 42 students (11.7%) completed the short survey. We believe that the low response rate is in part due to the very hectic nature of the final segment of the day. Students lingered in the exposition hall to talk to exhibitors, presenters and peers. There were also many students with pre-existing transportation arrangements (on buses or with parents) that prevented them from finding the quiet space to complete the survey. Even though the survey was relatively short—there were only seven items—many of the questions were open-ended to provide richer detail about students’ perceptions of the day. This may have also made it difficult for us to attain a higher response rate, and is something we will take into consideration as we design the evaluation instruments for the next STEMcx Expo.



In the next section of this memo we present the findings from the satisfaction survey and focus groups. First, we will review the grades that students gave each segment of the day. Then we present the findings from the open-ended questions on the survey and the focus group highlighting the important themes related to how students appraised each of the segments, the types of things that were most popular or exciting to them, and the advice that students would offer organizers for improving STEMcx next year.

Grading the STEMcx Segments

The first question on the student satisfaction survey asked students to give each segment of the day a grade from A-F. Students were instructed to only grade sessions that they attended, which resulted in a small sample size per session. The results in Table 1 illustrate the percentage of students in each session who assigned that session a particular grade. For example, 75% of the students who scored the Keynote Address gave it a grade of “A,” 15% gave it a “B,” and so on. It is notable that for all of the sessions, the majority of students graded the sessions either “A” or “B.” These findings clearly illustrate a very high level of satisfaction with the each segment of the Expo.



Table 1: "Student Grades" of the STEMcx Expo by Segment



Session	STUDENT "GRADES"				
	A	B	C	D	F
Keynote Address	75%	15%	5%	5%	0%
The Chemistry of Covergirl	26.6%	57%	0%	0%	14.3%
The Physics of Basketball	80%	20%	0%	0%	0%
The Engineering Challenge	62.5%	0%	37.5%	0%	0%
Operating Room 101	50%	50%	0%	0%	0%
CSI Baltimore	80%	20%	0%	0%	0%
To Infinity and Beyond	28.6%	57%	14.3%	0%	0%
So You Want to Be a Gamer	100%	0%	0%	0%	0%
The Need for Speed	100%	0%	0%	0%	0%
(Presentation) Science and Engineering Internships	87.5%	0%	0%	0%	12.5%
Health Care Panel	100%	0%	0%	0%	0%
STEMcx Fair and Expo	57.1%	28.6%	14.3%	0%	0%

**Building Tomorrow's Architecture received 0 surveys*

Student Impressions of STEMcx: In their own words

“STEMcx can open your mind to new adventures—science is not just sitting in a lab doing nothing! This experience can help you figure out what you want to be!” (Girl, 11th grade)



The open-ended questions on the survey and the focus group discussion allowed us to get students’ impressions about their overall experience of STEMcx in their own words. In this brief section, we report on the four key lessons students offered about STEMcx:

- Students really enjoyed the STEMcx experience, and particularly appreciated the interactive nature of the STEMcx Expo
- Students valued interacting with African Americans STEM professionals
- The STEMcx experience had an immediate impact on students’ attitudes toward school
- STEMcx was very appealing to both girls and boys, contrary to the expectations that girls would be harder to attract to the event

Each of these themes is explored in more detail below.

1. Students really enjoyed the STEMcx experience, and particularly appreciated the interactive nature of the STEMcx Expo

The majority of survey respondents felt positively about the overall STEMcx experience, writing that it was “fun,” that they “learned a lot” and it gave them “aspiration” for the future. Some representative quotes from the surveys illustrate an overwhelmingly positive appraisal of the EXPO: We were able to get more detail about students’ impressions of the Expo from focus group participants.

Each of them expressed appreciation for the fact that the conference did not “feel like school,” and that there was no need for lectures or notes. The interactive nature of the workshops was clearly the most appealing part of the conference for many of the students.

“I learned a lot from the conference and it was very educational.”

“It teaches you how STEM can help you in the long run in life.”

“Overall the conference was very effective in giving a broad view of information.”

“Yes, I would recommend this for my friends. It made me feel like I was in a mini college”

Due to the deep level of engagement in the workshops they attended, all of the students in the focus group were able to recall details about the experiences they had, and were visibly excited about what they had learned. Having the opportunity to perform experiments and build things was very powerful. This aspect of the conference was also reflected in survey responses about what students learned from the conference that really made an impact. Survey respondents reported that



the experiments, such as illustrating how the colors of the rainbow are produced and learning about bone aging or how to use fingerprints at a crime scene “wowed” them.

Some of their most compelling quotes from the survey results further illustrate what students found most exciting and awe-inspiring:

"The things that are used to find out about crimes scenes and the ingredients used in cosmetics."

"That you can tell a person's age and their life story just from their bones."

"I never knew that there was an occupation called a neurologist."

"In the operating room I saw the tools they used when they do an operation. I was amazed."



2. Students valued interacting with African American STEM professionals

One of the most impactful elements of STEMcx was the opportunity to engage with African-American professionals during every segment of the conference. As one student commented,

"It was inspiring for me because some—not all, but some—Caucasian people look down on you because of the color of your skin, but when you see someone who's African American running the show and running everything you say 'Hey! I can do that too!'" (Boy, 7th grade).



In addition to the general sense of awe at meeting and interacting with so many African American scientists and engineers, one student remarked about how important it was to see African American women in positions of authority at STEMcx:

"It inspired me, because in history and down to today they say women aren't supposed to do anything but be housewives, so to see women—African American women or any women—come and be able to teach the whole class about science and bone structures was inspiring because you know that you can do it too as long as you have faith in yourself." (Girl, 11th grade)



The students in the focus group were very impressed to meet an African American university president (and were impressed that he seemed "young" for the job!) Dr. Hbrawoski's remarks left a deep impression, as evidenced by the fact that students were able to quote some of the passages from his talk, as one young woman illustrates in her remarks:



"He said that thoughts become actions, actions become habits, and habits form

character. I learned from that because it's actually true!" (Girl, 11th grade)

In addition to Dr. Hbrawoski's remarks, all of the students found the UMBC Meyerhof Scholar he introduced at the keynote address to be particularly inspiring, saying that he proved that "you can do whatever you put your mind to, no matter where you come from."

3. The STEMcx experience had an immediate impact on students' attitudes toward school.

While we would not expect a one-day event to be life changing, we did have expectations that the conference would be inspirational and could motivate some immediate changes in participants' attitudes toward their performance in school. The post-conference survey asked students about whether they saw or learned anything that will influence them when they get back to school next week, and the responses were encouraging. Most youth reported that the conference influenced them to apply themselves more in school, saying that they will "pay more attention in class" and "work harder." One participant shared that because of the conference, she now knows that South African kids are happy to learn and "we can be also."

It is notable that **all** of the students in the focus group were already very interested in STEM academic disciplines and careers before attending the conference, and they described themselves as "highly motivated" or "high achievers." Across the board, this sub-group of conference attendees was very concerned about their grades and planning for the future, and took a lot away from the conference that they will apply immediately to their studies:



"Before today, I wanted to be a journalist or a forensic scientist and I thought forensic science was just SCIENCE, but I realized today that math has a lot to do with A LOT of the careers out there, so I will take math more seriously now" (Boy, 7th grade).

The recognition of the need to take their studies more seriously was echoed by each of the students in the focus group. One of the girls, a junior in high school, noted that "I realized I DO have to pay attention in my classes, especially in math classes and geometry because geometry plays a role in everything." Another young lady offered an even more precise observation about STEMcx's impact on her attitude:



"Coming here today made me see that it is more serious than I'm now taking it, so it really inspired me to do better in science, math and social studies to prepare me for what I want to do." (Girl, 7th grade)

We would not have expected one day to significantly change the plans or goals of the conference participants, and this was borne out in the conversations with them. As one 11th-grade girl explained, "Today didn't change what I want to be, it just opened my mind to a broader experience." What is notable, however, is that **all** of the students in the focus groups left STEMcx with a higher level of motivation to succeed and new ideas about the possibilities open to them.

4. STEMcx organizers should consider special outreach to boys as they organize the next conference.



Because it was clear that the students in the focus group did not represent the general student body in Baltimore, given their high-levels of future-orientation, the seriousness with which they approach their studies and their interest in STEM disciplines and careers, we asked them to help STEMcx organizers understand how to motivate their peers who may be less motivated or less interested in attending an event like STEMcx. Specifically, we asked them to comment on what organizers could do to get more boys interested in an event like STEMcx, because contrary to what organizers had anticipated, the attendance rate for girls at the event was quite high.



Strikingly, the students went directly to the heart of the matter. One 6th grade boy said that other boys “don’t take school seriously and they like to sit around and play video games all day.” Another boy from the 7th grade went even deeper:

“There are way more girls in the gifted and talented classes in my school because the boys are so focused on being cool and they are afraid that if people see them as smart they won’t be in that high-ranking of coolness.”



The level of honesty and introspection of the students in the focus group suggests that we can and should take their comments into account as plans are developed for outreach and recruitment to STEMcx 2012.



Comments and Reflections

The first STEMcx conference was a success by many measures: student enrollment reached capacity; there was parity in the gender representation of participants; students were highly engaged in each of the sessions and reported learning new things and being inspired to apply themselves in school now and pursue STEM careers in the future. The level of excitement about the subjects covered during the conference was



palpable during the workshops, and was evident in the survey responses as well as focus group discussion. Very few students gave the sessions low marks, and only had a few specific recommendations for improving the event next year, which fall into five categories:

- Workshops should be organized into two middle-school and high-school clusters so that the facilitators can tailor the presentation and exercises to the attention span and ability level of each group.
- Organizers should develop innovative ways to advertise and reach out to students who are not already doing well in STEM-related classes in school.
- STEMcx planners may consider adding even more workshops to allow participants to enroll in more than two, and to accommodate more students at the conference overall.
- Organizers should consider reducing the time spent on speeches and discussion panels so that more time

can be spent on hands-on activities that engage students directly.



- Organizers may want to consider planning the conference around shorter sessions so that the day is not 8 hours long.

The STEMcx organizers can proudly say, "Mission accomplished!" Students left the day motivated to succeed and to apply the lessons they learned immediately to their studies. They left with role models that they will hold in mind as they plan their own STEM careers. Their imaginations were stimulated, and they saw first hand that "you can do anything that you put your mind to." We suspect that the biggest challenge for organizing STEMcx 2012 will be managing the overwhelming demand, as all of the students we interacted with planned to tell their friends to make sure to attend the event next year.



Workshop Presenters and Stem Fair Exhibitors

The organizers want to give special thanks to the workshop presenters who were the key component in the event's success. In addition, the interactive exhibit hall in the second half of the afternoon introduced a myriad of interactive activities focused around STEM.

OPERATING ROOM 101

Presenters: Health Professionals at LifeBridge Health and

THE CHEMISTRY OF COVER GIRL

Presenters: Scientists at Proctor & Gamble

THE ENGINEERING CHALLENGE

Presenters: Engineers at Northrop Grumman and staff at Microsoft

BUILDING TOMORROW'S ARCHITECTURE

Presenters: Students from Morgan's School of Architecture and Planning and a representative from The National Building Museum

SLAM DUNK: THE PHYSICS OF BASKETBALL

Presenters: Physicist, author and, Professor John Fontanell, and Charles Choo Smith, former Harlem Globetrotter



SO YOU WANT TO BE A GAMER

Presenters: Tyrone Adams, President of Anysolv Technologies, Inc, and Brian Jackson, Creative Director at Nergyzed Entertainment.

SCIENCE AND ENGINEERING INTERNSHIPS AEOP:

Presenters: Scientists and Engineers from the Army Educational Opportunity Program



THE NEED FOR SPEED: AUTOMOBILE DESIGN AND FUEL EFFICIENCY

Presenters: The EVX Team from Philadelphia, and John Murach, Director of Business Planning and Corporate Performance, BGE.

CSI BALTIMORE:

Presenters: Dana Kollman, Towson Professor and former Forensic Services Technician with Baltimore County Police Department; and Howard Schindler, professor of forensics, at Stevenson University in Maryland, and Dawn Johnson forensic scientist with the Montgomery County Police.

TO INFINITY AND BEYOND

Presenters: Trena Ferrell, Maryland Education Liaison for NASA and representatives of the Space Telescope Science Institute on the Johns Hopkins University Campus.

STEM Fair Exhibitors

Extension-Baltimore City-4h



Morgan State University Science and Technology Division

Coppin State University

University of Baltimore

University of Maryland

Voyage of Exploration S.T.E.M.Project

Center for Talented Youth Johns Hopkins
University

Girl Scouts of Central Maryland

Oak Ridge Institute for Science and
Education

Walter Reed Army Institute of Research

BITHGROUP Technologies

Northrop Grumman

