Report of Survey Results from 2016-2017 C-STEM Participants

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Executive Summary

Communication, Science, Technology, Engineering, and Mathematics (C-STEM) is a Houston-based education nonprofit (501(c)(3)) that provides hands-on, STEM-focused learning opportunities to underserved and underrepresented students in grades Pre-K through 12, as well as professional training in STEM education to teachers. C-STEM evaluates its programming each year to learn about and from its students and teachers.

The purpose of the present evaluation is to address three of C-STEM's goals, Goal 3 (*Increase students' 21st century skills and STEM literacy through competition*), Goal 5 (*Increase teacher capacity to deliver STEM content grades Pre-K-12 STEM*), and Goal 7 (*Increase students' interest in and capacity to pursue careers in STEM-related fields*). To do so, a survey was administered to participating teachers and students in the spring of 2016-2017 in order to examine students' experiences with, attitudes towards, and interest in STEM and STEM careers (Goal 7 above) and their 21st century skills (Goal 3 above), as well as teachers' experience with C-STEM's professional development (Goal 5 above).

A total of 137 students responded to the online survey for a response rate of 25.6%, and 29 teachers responded to the survey for a response rate of 60%. Several key findings emerged from the analyses:

- In terms of students' STEM dispositions:
    - Secondary males were more confident than secondary females about advanced math; there were no differences among elementary students;
    - There were no significant differences for elementary students in terms of race;
    - Among secondary students, the African American and Latino students were more positive than the White and Asian students about their prospects in mathematics and advanced mathematics, though that relationship was reversed for science;
    - Elementary students with previous C-STEM experience were more positive about their abilities in mathematics and advanced mathematics, in contrast to responses in the 2015-2016, when they were more negative;
    - There were no differences among secondary students according to previous C-STEM experience.
- In terms of their career interests:
    - Elementary and secondary students on average rated themselves as 'interested' in all of the careers;
    - There were no significant associations between the career preferences expressed by the male vs. the female elementary students;
    - There also were no significant relationships between career interest and student race/ethnicity, or between career interest and prior STEM experience among the elementary school students;

    - Several relationships were found among the secondary students, including between males and females (males were more interested in physics, computer science, and engineering), and among racial/ethnic groups (African American and Latino students were more interested in environmental work, biology, and zoology compared to White students, and more interested in medical science compared to Asian students);
    - No differences were detected according to prior STEM experience among secondary students.
- The report also presents results from a survey of C-STEM teachers:
    - C-STEM's teachers are very racially and ethnically diverse compared to national averages;
    - Over half were from elementary schools and they reported teaching students over varying levels;
    - Approximately a third of the teachers reported having participated in a professional learning community or study group, and just over a quarter reported participating in C-STEM's trainings.
- In terms of how the teachers implemented C-STEM:
    - They reported implementing the program more often than comparable STEM programs;
    - About half of the teachers selected between 25% and 74% of the modules available to them;
    - Just over 60% of the teachers reported placing lots or heavy emphasis on real-life applications of STEM, and on preparing students for further study in STEM;
    - Finally, over half of the teachers reported using the internet, personal computers/laptops, and mobile phones often or most of the time.
- C-STEM also provides professional learning opportunities to the teachers and, overall, the teachers felt prepared to teach C-STEM with diverse students.
- Trends in implementation were linked to aggregate student responses:
    - The analysis pointed to some differentiation among the elementary schools, with a private school emerging as a 'high' implementation and 'high' outcomes campus;
    - Across the secondary campuses, program implementation was relatively consistent and high;
    - There was no systematic relationship between implementation and student responses at the secondary level.
- Compared to previous years, the students who responded to the survey in 2016-2017 year were more positive about STEM than the students who responded in the 2015-2016:

- The elementary students were more positive in their outlooks in 2016-2017 when compared to the elementary students in 2015-2016, but the opposite was true for the secondary students, who overall were less optimistic in 2016-2017;
- The elementary students expressed slightly higher interest in STEM careers in 2016-2017;
- In contrast to the secondary students' intentions regarding advanced STEM coursework and college, more secondary students expressed interest in STEM careers in 2016-2017 than in 2015-2016;
- Finally, in 2016-2017, there was a larger percentage of elementary and secondary students who only had participated in C-STEM and reported not having participated in other STEM programs.

The report concludes with three sets of recommendations relating to teacher training, areas for future research, and ways to improve future data collection and evaluation efforts for C-STEM.

Introduction to C-STEM

Communication, Science, Technology, Engineering, and Mathematics (C-STEM) is a Houston-based education nonprofit (501(c)(3)) that provides hands-on, STEM-focused learning opportunities to underrepresented and underserved students in grades Pre-K through 12, and professional training in STEM education to teachers.

The program's mission is "*to inspire the next generation of innovators and thought leaders by engaging them in exciting hands-on projects solving real world problems to encourage entry into the talent pipeline, bolster self-confidence, and foster a well-rounded mastery of the areas of communication, science, technology, engineering, and mathematics*."

The program seeks "*to enrich curriculum and instruction through integrated STEM learning experiences*."

C-STEM's goals are to:

1. Empower students to become innovators and technologically proficient problem solvers;
2. Ensure that students have access to the appropriate STEM instructional resources conducive to enhancing their learning experiences both inside and outside of the traditional classroom setting;
3. Provide students' opportunities to apply 21st century and STEM literacy skills in competitive environments;
4. Enrich community understanding of STEM education and its importance in building capacity to prepare students for work and life in the 21st century;
5. Provide teachers with the opportunity to deliver high quality relevant project-based learning STEM content grades Pre-K-12 STEM;
6. Serve as a channel for connecting classroom learning with the business sector to improve students' college and career readiness skills;
7. Provide students' exposure to careers in STEM-related fields.

According to C-STEM, what sets it apart from other enrichment STEM programs is that it:

- Integrates communication with STEM education; literacy is necessary for student success in math and science;
- Uses a research-based model that was piloted in 2002 and expanded with funding from Shell Oil Company;
- Creates Pre-K-12 pipelines by providing opportunities for schools to work as collaborative partners;
- Supports teachers with STEM training and supplemental workshops to support successful implementation;
- Provides schools with STEM instructional tools and resources; and it
- Fosters a competitive environment that supports high performance and accountability for both teachers and students.

Every year, C-STEM's curriculum has a new focus and during the 2016-2017 school year, the focus was, "The Urban Nexus: Improving the Quality of Life." As part of this, students had to analyze the multiple challenges that cities face as their populations grow. For example, students had to consider what infrastructure might need to be built, in what ways designing good infrastructure can help mitigate the negative effects of pollution and over-crowding, and how to balance the benefits of sustainable infrastructure with the costs. Students had to design their own solutions to the challenges posed by conducting original research and applying that knowledge.

Each spring, student teams compete in the CSTEM Challenge, which serves as an end of the year capstone project. According to the founder, Dr. Reagan Flowers, the "CSTEM Challenges serves as our performative evaluation, and their capstone project in a competitive environment." In 2016-2017, students competed in any of eight areas: Robotics, Innovation, Computer Programming, Debate, Photography, Mural, Sculpture, Film, and Sculpture.

Evaluation of the Program

C-STEM evaluates its programming each year to learn about and from its participants. Previous evaluations have covered 2002-2007 and 2011-2016 (all reports are available for download at www.cstem.org). The purpose of the present program evaluation is to address three of C-STEM's goals, Goal 3 (*Increase students' 21st century skills and STEM literacy through competition*), Goal 5 (*Increase teacher capacity to deliver STEM content grades Pre-K-12 STEM*), and Goal 7 (*Increase students' interest in and capacity to pursue careers in STEM-related fields*). To do so, a survey was administered during the spring of the 2016-2017 school year to participating teachers and students in order to examine students' experiences with, attitudes towards, and interest in STEM and STEM careers (Goal 7) and their 21st century skills (Goal 3), as well as teachers' experience with C-STEM's professional development (Goal 5).

The evaluation seeks to answer the following specific questions:

1. What were students' attitudes towards and interest in STEM and STEM careers, and how do those attitudes compare to those of the students who participated in 2015-2016?
2. How did students perceive their own 21st century skills, and how do those perceptions compare to those of the students who participated in 2015-2016?
3. What were teachers' experiences with the professional learning opportunities that C-STEM provides?
4. How did teachers implement C-STEM?

The design of the evaluation allows for the presentation of summary descriptive statistics about the students and teachers who participated and for the comparison of subgroups of students and teachers within the sample of participants. In addition, because the same survey was administered in the 2015-2016 school year, responses for the two years and two cohorts of students can be compared in aggregate and across subgroups.

A total of 1,440 students participated in C-STEM in 2016-2017, though not all of those students participated in the end of year CSTEM Challenge. A total of 137 students responded to the online survey for a response rate of 25.6%. Some students completed the survey in their classrooms in the spring semester, while others completed it during the annual C-STEM

Challenge in late May of 2017. A total of 48 teachers participated in C-STEM in 2016-2017, and 29 teachers responded to the survey for a response rate of 60%. What follows is a description of the surveys and their results. Where possible, results from 2016-2017 will be compared to those from 2015-2016.

Student Survey Results

Student Survey Instruments

Students' attitudes towards STEM were measured using an abridged version of the *Students' Attitudes Towards STEM* survey (Unfried, Faber, & Wiebe, 2014; Unfried, Faber, Stanhope, & Wiebe, 2015). The survey was created with the support of the National Science Foundation and has been validated. Two versions of this survey are available: One for upper elementary (grades four and five) and one for secondary (middle and high school) students, though the questions are very similar (See Appendix A for a full copy of the original surveys).

The original surveys comprise four scales that, together, measure students' attitudes towards STEM as well as towards 21st century skills. The scales are attitudes towards engineering, attitudes towards mathematics, attitudes towards science, and attitudes towards 21st century skills. All four scales utilize a five-point Likert scale for the response options (1= Strongly disagree to 5= Strongly agree). C-STEM administered an abridged version of the survey (See Appendix B for full copies of the C-STEM versions) and so only two of the four scales were fully measured: Attitudes towards engineering and towards 21st century skills. The surveys also both include a section of 12 items asking about students' relative interest in specific STEM and STEM-related careers.

Table 1 below presents the reliabilities (Cronbach's alpha) for each of the two scales included in the survey for both the elementary and secondary C-STEM administrations. The reliabilities were high for the 21st century skills scales (0.85 for elementary and 0.87 for secondary), and in line with the reliabilities from the 2015-2016 administration of the survey (0.86 and 0.88 for the elementary respondents, respectively). Reliabilities for the engineering scale (0.74 for elementary and 0.82 for secondary) were not as high as they were in 2015-2016 (0.85 for elementary and 0.91 for secondary). These reliabilities, however, remain consistent with what the authors of the survey have reported (Unfried et al., 2015) and are still acceptable.

Table 1: Reliability of scales for elementary and secondary respondents

Scale	Elementary	Secondary
Engineering	0.74	0.82
21st century skills	0.85	0.87

Student Demographics

In this section, descriptive statistics are presented for the students who responded to the survey. In general, C-STEM stands out because it serves students who are underrepresented in STEM education and careers, particularly Latinos and African Americans. Comparable programs such as GirlStart (http://girlstart.org/wp-content/uploads/2017/06/Strong-Promise-Article-and-Appendix.pdf), 4-H, and FIRST Robotics serve smaller proportions of Latinos and African Americans, and much larger proportions of White students. In 2016-2017, 33.3% of the elementary students were male and 66.7% were female (Table 2). Of the secondary students, 52.5% were male and 47.5% were female, a distribution that was more balanced than in the 2015-2016 year (in that year, participants were 55.2% were male and 44.8% were female). These numbers are in line with (e.g., Vandell et al., 2006) or higher than (e.g., Karp & Mahoney, 2013) other similar co-educational afterschool programs. For the secondary students, a nationally representative survey of over 22,000 students reported that among 9th grade students participating in afterschool programs such as mathematics or science clubs and competitions, approximately 55% of participants were male, and 45% were female (NCES, 2009).

Table 2. Students' sex

Student Sex	Elementary Students		Secondary Students	
	Frequency	Percent	Frequency	Percent
Male	19	33.3%	42	52.5%
Female	38	66.7%	38	47.5%
Total	57	100%	80	100%

In terms of students' race and ethnicity, the majority of elementary and secondary students were either African American or Latino. Specifically, as Table 3 depicts, 50 percent of the elementary students identified as African American, and just under a quarter as Latino. The remaining students identified as Asian (16%), White (6%), and Native American (6%). It should be noted that almost half of the elementary students (44%) did not respond to this question. Among the secondary students, almost three quarters of students were either African American (37.5%) or Latino (35%), and the remaining students identified as Asian (16.3%), White (10%), and as of two or more races (1.3%). C-STEM's students are very diverse when compared to participation among students nationally. A nationally representative survey of students found that only approximately 15% of students participating in STEM enrichment programs were Latino and approximately 15% were African American (NCES, 2009).

Table 3. Student race and ethnicity

	Elementary		Secondary	
	Frequency	Percent	Frequency	Percent
African American	16	50%	30	37.5%
Latino	7	22%	28	35%
White	2	6%	8	10%
Asian	5	16%	13	16.3%
Native American	2	6%	0	0%
Two or more races	0	0%	1	1.3%
Missing	25		0	
Total	57			

Of the elementary students, three quarters responded that they only had participated in C-STEM programs, and not other kinds of STEM programs (Table 4). For the secondary students, that number was even higher: Almost 65% of them only had participated in C-STEM programs. Twenty percent of elementary students and a quarter of secondary students had participated in between one and five other STEM programs, while only one elementary and 7 secondary students had participated in six to 10 STEM programs prior to their participation in 2016-2017 in C-STEM. Finally, no elementary students and only one secondary student reported participating in more than 10 STEM programs. In other words, these data suggest that C-STEM continues to serve a population of students that other STEM education organizations are not reaching.

Table 4. Prior participation in C-STEM or other STEM programs

	Elementary		Secondary	
	Frequency	Percent	Frequency	Percent
1-5 STEM programs	11	19.3%	19	24.7%
6-10 STEM programs	1	1.8%	7	9.1%
More than 10 STEM program	0	0.0%	1	1.3%
Only C-STEM programs	43	75.4%	50	64.9%
Total	55	100%	77	100%
Missing	2	3.5%	3	3.75%

Almost all of the students were positive about their experience with C-STEM and other STEM programs (Table 5). At the end of the 2016-2017 year, 90% of elementary students reported they would participate in future STEM programs, which was higher than the percent of positive responses in 2015-2016 (86%). Secondary students, however, were less sure they would participate in future STEM programs: Just over 80% expressed their intention to participate in future programs, compared to 95% in 2015-2016.

Table 5. Students' intention to participate in future STEM programs

	Secondary		Elementary	
	Frequency	Percent	Frequency	Percent
No	8	10%	11	19.3%
Yes	72	90.0%	46	80.7%
Total	80	100%	57	100%

C-STEM works with teachers and students from Pre-K through 12th grade. Among the students who responded to the survey, 42% came from elementary school (defined as grades K-5), just under a third were from middle school (grades 6-8), and the remaining 30% were from high school (grades 9-12), as depicted in Table 6 below. The make-up of the elementary school sample (over 40% second and third grade students) means that the elementary results should be interpreted with caution: The instrument was designed for fourth and fifth graders and may not be valid or reliable for younger students.

Table 6. Grade level distribution

Grade Level	Frequency	Grade Level Percent	Total Percent
2nd grade	8	14.00%	6%
3rd grade	15	26.30%	11%
4th grade	34	59.60%	25%
5th grade	0	0%	0%
Subtotal	**57**	**100**	**42%**
6th grade	14	17.50%	10%
7th grade	12	15%	9%
8th grade	12	15%	9%
9th grade	6	7.50%	4%
10th grade	11	13.80%	8%
11th grade	14	17.50%	10%
12th grade	11	13.80%	8%
Subtotal	**80**	**100**	**58%**
Total	137		100%

C-STEM is an open enrollment program that allows schools to enter the program as they have the capacity to do so. There are no contracts, and C-STEM provides services to those schools that are able to register for the program by the deadline each year. Registration is affected when superintendents, principals, and teachers leave a school or district and, as a result, C-STEM has high *district* retention rates, but not *school* retention rates. As an example, schools from the Houston Independent School District (HISD) have participated in C-STEM for 16 consecutive years, but not the same schools each year. Similarly, Prince George's County Public Schools in Maryland has participated for six years, and the Michigan Charter School System and the Wisconsin Private School System have participated in C-STEM for four years.

In the 2016-2017 school year, a total of 20 schools participated in C-STEM, up from 14 in 2015-2016. Sixteen schools were from Houston, Texas, two schools from Detroit, Michigan, and two schools were from Wisconsin. The schools are a mix of public, public charter, and private schools. Of the students who responded to the survey, 17 schools were represented (see Table 7).

Table 7. Distribution of students from participating schools

Elementary Schools	City & State	Frequency	Valid Percent
Missing	Missing	3	5.3
Francone Elementary	Houston, TX	14	24.6
Gregg Elementary	Houston, TX	2	3.5
Holy Redeemer Christian Academy	Milwaukee, WI	2	3.5
Paul Robeson Malcolm X Academy	Detroit, MI	2	3.5
Tekoa Academy	Port Arthur, TX	16	28.1
Windsor Village Elementary	Houston, TX	7	12.3
Beatrice Mayes Institute	Houston, TX	9	15.8
Betsy Ross Elementary	Houston, TX	2	3.5
Subtotal		57	100
Secondary Schools/Programs			
Archway HS	Houston, TX	8	10
Sharpstown International HS	Houston, TX	11	13.8
Westside HS	Houston, TX	3	3.8
Energy Institute	Houston, TX	8	10
Young Coggs HS	Milwaukee, WI	4	5
Hamilton MS	Houston, TX	4	5
Killough MS	Houston, TX	11	13.8
Tekoa Charter School	Port Arthur, TX	25	31.3
Holy Redeemer Christian Academy	Milwaukee, WI	2	2.5
Save a Girl, Save a World	NC	3	3.8
Subtotal		80	100

Of the students who responded to the survey, most were very interested in STEM careers (Table 8). Specifically, just over 80% of secondary students and 90% of elementary students indicated they were. Compared to responses in 2015-2016, fewer secondary students were interested (85% in 2015-2016), but more elementary students were interested (80% in 2015-2016). As with the results from the 2015-2016 school year, C-STEM participants report a substantially higher interest in STEM careers than students who participated in a similar afterschool science program run by the 4-H club, the Science Initiative, which is supported by the Noyce Foundation. Among those students, 54% agreed or strongly agreed they were interested in science-related career (Mielke, LeFleur, Bulter, & Sanzone, 2012). The C-STEM students also reported higher levels of interest than students participating in a range of classroom-based, elective, or informal STEM programs (Faber et al., 2013)

Table 8. Students' interest in STEM-related careers

	Secondary		Elementary	
	Frequency	Percent	Frequency	Percent
No	10	10%	11	19.3%
Yes	70	90%	46	80.7%
Total	80	100	57	100%

When asked whether their parents supported their interest and participation in STEM, students overall provided a positive assessment, though lower percentages of students reported parental support than in 2015-2016 (Table 9). Support was similar for the parents of elementary students (75.6%) as compared to the parents of secondary students (76.25%).

Table 9. Parental support of student's participation in STEM

	Secondary		Elementary	
	Frequency	Percent	Frequency	Percent
No	19	23.75%	14	24.6%
Yes	61	76.25%	43	75.6%
Total	80	100%	57	100%

Student Academic Background and Self-Assessment

The survey also asked students to rate their own abilities in mathematics and science, as well as to summarize their expected performance in English language arts, mathematics, and science. Responses to these questions were examined in the aggregate and then were disaggregated by gender and prior experience with C-STEM.

Aggregate responses. The first three questions, asking students to rate their ability in mathematics and science, were Likert scale questions in which students were asked to indicate the extent to which they agreed or disagreed with the statements made. The secondary students overall were more positive than the elementary students (Table 10). For the first of the three items, "I can handle most subjects well, but I'm bad at math", the secondary students had a slightly higher average score, which means more of them agreed or strongly agreed with the statement and were negative about their abilities in mathematics. For the second item, "I'm sure I could do advanced math work", the elementary students had a slightly higher average response, which meant that more agreed or strongly agreed with the statement, a result consistent with the responses to the previous question. Finally, for the third item, "I can handle most subjects, but I can't do well in science", elementary students had a higher average score than the secondary students, which means that more of them agreed or strongly agreed with the statement and were less optimistic about their prospects in science.

Table 10. Comparison of secondary and elementary students' attitudes towards mathematics and science

	Elementary		Secondary	
	Mean	Standard deviation	Mean	Standard deviation
I can handle most subjects well, but I'm bad at math	2.14	1.32	2.53	1.36
I'm sure I could do advanced math work	4.16	1.16	3.68	1.25
I can handle most subjects, but I can't do well in science	2.42	1.34	2.16	1.19

When the responses were broken down, the differences remained clear (Table 11): Over 50% of the secondary students and just over 65% of elementary students either disagreed strongly or disagreed with the statement, "I can handle most subjects well, but I cannot do a good job with math." In other words, a majority of both groups of students did *not* agree that they are not good at math. Just over 30% of secondary students and fewer than 20% of elementary students did agree or strongly agree with the statement. Compared to results from the 2015-2016 survey results, the secondary students were less positive in 2016-2017, while the elementary students were more positive about mathematics.

Table 11. I can handle most subjects well, but I cannot do a good job with math

	Secondary		Elementary	
	Frequency	Percent	Frequency	Percent
Strongly disagree	27	33.8%	25	43.9%
Disagree	15	18.8%	14	24.6%
Neither agree nor disagree	12	15.0%	8	14.0%
Agree	21	26.3%	5	8.8%
Strongly agree	5	6.3%	5	8.8%
Total	80	100	57	100

The next question prompted students with the statement, "I am sure I could do advanced math." Unlike the first question about mathematics, the secondary and elementary students both responded positively to this prompt (Table 12). Seventy percent of the secondary students and 80% of elementary students either agreed or strongly agreed with the statement. As with the prior question, the elementary students were more confident about their prospects in math. When compared to the results from the 2015-2016 year, students were more positive in 2016-2017.

Table 12. I am sure I could do advanced math

	Secondary		Elementary	
	Frequency	Percent	Frequency	Percent
Strongly disagree	7	8.8%	3	5.3%
Disagree	10	12.5%	4	7.0%
Neither agree nor disagree	7	8.8%	4	7.0%
Agree	34	42.5%	16	28.1%
Strongly agree	22	27.5%	30	52.6%
Total	80	100	57	100

The third and final question mirrored the first, but was about science instead of mathematics (Table 13). Both the elementary and secondary students were positive in their assessment of their ability in science, though the secondary students were not as positive as they were in 2015-2016 (almost 90% of students either disagreed or strongly disagreed with the statement). Specifically, almost 70% of secondary students and just over 60% of elementary students either disagreed or strongly disagreed with the statement, "I can handle most subjects well, but I cannot do a good job in science"; the elementary students in 2016-2017 were more positive than they were in 2015-2016 when approximately 50% of them either disagreed or strongly disagreed with the statement. On the other hand, 20% of secondary students and almost 30% of elementary students (more than in 2015-2016) agreed or strongly agreed with the statement.

Table 13. I can handle most subjects well, but I cannot do a good job with science

	Secondary		Elementary	
	Frequency	Percent	Frequency	Percent
Strongly disagree	30	37.5%	18	31.6%
Disagree	25	31.3%	18	31.6%
Neither agree nor disagree	9	11.3%	4	7.0%
Agree	14	17.5%	13	22.8%
Strongly agree	2	2.5%	4	7.0%
Total	80	100	57	100

Several questions asked the students the extent to which they agreed with a set of statements about engineering and about their own 21st century skills (Table 14). In order to summarize students' dispositions toward both, an index was created for each in which students' scores across the items were averaged. For both grade levels, the students were more positive about their own 21st century skills than they were about engineering (elementary 21st century skills: $M = 4.13$ vs. engineering: $M = 3.96$; secondary 21st century skills: $M = 4.13$ vs. engineering: $M = 3.96$). For both scales, the secondary students were more positive than the elementary students. For both elementary and secondary students, the C-STEM students had higher average responses than students involved in other STEM programs who responded to the same survey (Unfried et al., 2014). The 2016-2017 averages for both scales were approximately equivalent to the averages for the scales in the 2015-2016 year.

Table 14. Students' average scores for engineering and 21st century skills

	Elementary		Secondary	
	Mean	Std. Deviation	Mean	Std. Deviation
Engineering Index	3.96	0.27	3.96	0.19
21st Century Skills Index	4.13	0.13	4.13	0.10

The next set of questions asked the students to indicate whether they thought they were doing well in their classes, whether they thought they would take advanced mathematics or science classes, whether they would attend college, and whether they knew any adults working in STEM fields. Each had different answer stems. Table 15 summarizes the students' responses to the first set of questions about student performance in their classes. Very few of the secondary or elementary students expected to do poorly in any of the three classes: English language arts (ELA), mathematics, or science. Instead, the vast majority of both groups believed they would do either "OK/Pretty well" or "Very well". Indeed, over 90% of students in both groups indicated they expected to do either "OK/Pretty well in all three subjects.

Table 15. Students' expectations for performance in different classes

	Secondary			Elementary		
	ELA	Math	Science	ELA	Math	Science
Not very well	1.3%	7.5%	3.8%	3.5%	5.3%	1.8%
OK/Pretty well	45%	36.3%	32.5%	33.3%	22.8%	24.6%
Very well	53.8%	56.3%	63.8%	63.2%	71.9%	73.7%
Total	100%	100%	100%	100%	100%	100%

The next set of questions asked the students whether they thought they might enroll in advanced mathematics or science courses, and whether they thought they might go to college (Table 16). The results in 2016-2017 were somewhat different than in 2015-2016, when very few secondary students and slightly more elementary students answered negatively to all three questions. In 2016-2017, very few elementary students answered negatively (no to advanced mathematics, 1.8%; science, 14%, and college, 3.5%) and more secondary students answered negatively regarding mathematics and science (no to mathematics, 15%, science, 11.3%). In general, though, the students were positive about all three: Large majorities were confident about taking advanced mathematics, advanced science, and about attending college. Indeed, 91.3% of secondary students and 96.5% of elementary students believe they will attend college (in 2015-2016, 96.6% of secondary and 89.2% of elementary students expected to go to college). For a second year, the C-STEM students, both elementary and secondary, were more optimistic about going to college than students who participated in 4-H's Science Initiative (52%; Mielke et al., 2012).

Table 16. Students' intentions

	Secondary			Elementary		
	Math	Science	College	Math	Science	College
No	15%	11.3%	1.3%	1.8%	14.0%	3.5%
Not sure	25%	27.5%	7.5%	26.3%	22.8%	0%
Yes	60%	61.3%	91.3%	71.9%	63.2%	96.5%
Total	100%	100%	100%	100%	100%	100%

The final set of four questions asked students whether they knew any adults working as scientists, engineers, mathematicians, or technologists (Table 17).[1] In 2016-2017, approximately the same percent of secondary students reported knowing a scientist as in 2015-2016 (40% vs. 39.7%, respectively), but fewer reported knowing a mathematician (46.3% vs. 50%). A smaller proportion of secondary students reported knowing an engineer in 2016-2017 (65% vs. 75%) or a technologist (55% vs. 62.1%).

As with the 2015-2016 administration of the survey, more elementary students indicated that they knew an adult in that career than indicated they did not. Indeed, relatively low proportions of students in 2016-2017indicated that they were unsure, and a higher percentage of elementary reported knowing a scientist, engineer, or mathematician as compared to the secondary students.

Table 17. Whether the students know adults in work in STEM careers

	Secondary			
	Scientists	Engineers	Mathematicians	Technologists
No	38.8%	18.8%	32.5%	21.3
Not sure	21.3%	16.3%	21.3%	23.8
Yes	40.0%	65.0%	46.3%	55.0
Total	100	100	100	100
	Elementary			
	Scientists	Engineers	Mathematicians	Technologists
No	29.8%	15.8%	17.5%	NA
Not sure	14.0%	15.8%	5.3%	NA
Yes	56.1%	68.4%	77.2%	NA
Total	100	100	100	

Disaggregated responses. In this section, student responses are disaggregated in the following ways: According to sex, race, and by C-STEM participation. A series of Chi square tests of association were conducted to explore whether there were relationships between responses and membership in different groups. The tests were conducted using a significance level of 0.05 and all tests were conducted separately for elementary and secondary students.

Differences across student sex. In order to investigate whether there was any association between students' responses to the questions described in this section and students' sex, a Chi square test of association was conducted (Table 18). For the elementary sample, none of the

[1] The question stems did not provide any explanation regarding what these careers comprised. The survey administered to the elementary students did not ask whether they knew any adults working as technologists.

relationships was significant, which indicates that the elementary students' responses to the questions did not depend on their sex. In the secondary sample, there was only one significant relationship: More secondary males were confident about advanced math [χ^2 (4, n = 80) = 10.166, p=0.038]. In the 2015-2016 administration, there were more significant relationships as the secondary females were less positive about future STEM careers, more secondary females expected to do poorly in science than secondary male, and more males were sure about taking advanced mathematics courses than females, who were less certain. The differences between the two years are positive as the secondary females overall were positive about STEM and their potential in STEM careers and coursework.

Table 18. Differences according to student sex

Student Sex	Elementary	Secondary
	Significant	
Future participation in STEM programs	N	N
Interest in STEM careers	N	N
Parental support for STEM participation	N	N
Bad at math	N	N
Advanced math coursework	N	Y*
Bad at science	N	N
Expectations for ELA	N	N
Expectations for Mathematics	N	N
Expectations for Science	N	N
Future advanced mathematics classes	N	N
Future advanced science classes	N	N
College intentions	N	N
Know scientists	N	N
Know mathematicians	N	N
Know engineers	N	N
Know technologists	N	N
Engineering index	N	N
21st Century skills index	N	N

*Significant at p<0.05

Differences by student race. Another pair of Chi square analyses was conducted to test whether students' responses depended on student race or ethnicity. Because of the low n in some of the cells, the tests ultimately did not include all of the races and, for some of the questions (e.g., college intentions), a Chi square could not be calculated at all because there was no variability in responses across the groups. The results of the analyses suggest that there are no significant differences for elementary students in terms of student race (Table 19).

Among the secondary students, however, several differences emerged, though not in expected ways. For example, whether students believed they would participate in future STEM programs depended on race: Contrary to the conventional wisdom, larger proportions of White and Asian students responded 'no', compared to African American and Latino students [χ^2 (4, n = 80) = 12.071, p=0.017]. Similar results emerged in response to the question regarding whether students believed they were good at mathematics: Proportionately more White and Asian students responded negatively compared to the Latino and African American students [χ^2 (16, n = 80) = 35.467, p=0.003]. African American, Latino, and Asian students also were positive about advanced mathematics [χ^2 (16, n = 80) = 29.990, p=0.018]. Another relationship emerged in response to the question about how students expected to do in their science course: Proportionately more White students believed they would not do well compared to Asian, Latino, and African American students, and proportionately more Asian students believed they would do "OK/Pretty well" compared to the African American, Latino, and White students [χ^2 (8, n = 80) = 17.750, p=0.023]. Fewer African American, Latino, and White students believed they would take advanced mathematics [χ^2 (8, n = 80) = 18.857, p=0.016] or science [χ^2 (8, n = 80) = 16.842, p=0.032] courses in the future compared to Asian students, who proportionately were more likely to be unsure or sure about both. Finally, a one-way ANOVA test revealed that there were differences among the racial/ethnic groups in their attitudes toward engineering ($F(4, 75) = 2.523$, p = .048), though not toward 21st century skills. Comparisons to the previous year are not possible because the 2015-2016 administration did not ask students to identify their race or ethnicity.

Table 19. Differences according to student race

Student Race	Elementary	Secondary
	Significant	
Future participation in STEM programs	N	Y*
Interest in STEM careers	N	N
Parental support for STEM participation	N	N
Bad at math	N	Y*
Advanced math coursework	N	Y*
Bad at science	N	N
Expectations for ELA	N	N
Expectations for Mathematics	N	N
Expectations for Science	N	Y*
Future advanced mathematics classes	N	Y*
Future advanced science classes	N	Y*
College intentions	NA	N
Know scientists	N	N
Know mathematicians	N	N
Know engineers	N	N
Know technologists	N	N
Engineering index	N	Y*
21st Century skills index	N	N

*Significant at p<0.05

Differences by C-STEM participation. For this analysis, a second set of Chi square tests of association was conducted (Table 20). Prior participation in STEM programs has three categories: Only C-STEM programs, 1-5 STEM programs, and 6-10 programs[2]. Unlike in 2015-2016 when the elementary students who only had participated previously in C-STEM

[2] Only one elementary student reported having participated in six to 10 STEM programs. As such, all of the results compare students who have participated in C-STEM only or in one to five STEM programs.

expressed significantly less interest in participating in a future STEM program, in the 2016-2017 school year proportionately more elementary students reported interest in participating in future STEM programs compared to students who had participated in one to five STEM programs [χ^2 (2, n = 55) = 8.564, p=0.014]. Elementary students who previously had participated in C-STEM only also were much more positive about their abilities in mathematics [χ^2 (8, n = 55) = 19.240, p=0.014] and advanced mathematics [χ^2 (8, n = 55) = 24.147, p=0.002] relative to responses from 2015-2016 when the C-STEM-only students were more negative. In 2015-2016, the C-STEM-only elementary students reported lower levels of parental support for their participation in STEM, but in 2016-2017 there was no significant relationship. No other relationships were statistically significant within the elementary sample.

Among the secondary students who only had participated previously in C-STEM, no significant relationships emerged. Before conducting the analyses, two of the categories were collapsed because of low cell counts: The category 'more than 10 STEM programs' was collapsed into the 'six to 10 STEM programs' category. In contrast to responses in 2015-2016 when C-STEM-only students expressed relatively less interest in STEM careers and were more negative about their abilities in science, in 2016-2017 there were no significant relationships for these two variables. Similarly, all the remaining relationships that were found in 2015-2016 (i.e., C-STEM-only students were more positive about their performance in English language arts, less certain about whether they would take advanced science classes in the future, and fewer of them reported knowing a scientist) were not present in the 2016-2017 sample.

Table 20. Differences by C-STEM participation

C-STEM Participation	Elementary	Secondary
	Significant	
Future participation in STEM programs	Y*	N
Interest in STEM careers	N	N
Parental support for STEM participation	N	N
Bad at math	Y*	N
Advanced math coursework	Y*	N
Bad at science	N	N
Expectations for ELA	N	N
Expectations for Mathematics	N	N
Expectations for Science	N	N
Future advanced mathematics classes	N	N
Future advanced science classes	N	N
College intentions	N	N
Know scientists	N	N
Know mathematicians	N	N
Know engineers	N	N
Know technologists	NA	N

*Significant at p<0.05

Student Career Interests

The survey asked a series of questions about students' interest in a range of STEM and STEM-related careers. Table 21 depicts the elementary students' interests. The questions asked how interested students were in each of the careers, and the question prompt provided a description of each career. For example, physics is described as, "…the study of basic laws governing the motion, energy, structure, and interactions of matter. This can include studying the nature of the universe", and sample careers provided included: Aviation engineer, alternative energy technician, lab technician, physicist, and astronomer. There was a separate item for each career, so students were able to express their relative interest for each. The responses for the elementary sample were coded as follows: Not all interested=1, Not so interested=2, Interested=3, Very interested=4.

The responses indicate that, on average across the career options, students rated themselves as 'interested' in all of the careers, which was slightly higher than in the 2015-2016 administration. For the elementary students, the most popular career options were engineering (*M*=3.12), computer science (*M*=3.09), and medicine (*M*=3.02). In 2015-2016, mathematics was among the most popular, as were computer science and engineering. The least popular options were medical science (*M*=2.67), energy (*M*=2.70), and physics (*M*=2.75). When the responses are broken down, it becomes clear that the majority of students was either interested or very interested in each of the careers, as was the case in 2015-2016. Indeed, the following careers had at least 70% of the elementary students responding that they either were 'interested' or 'very interested': Physics, environmental work, veterinary science, medicine, earth science, computer science, and engineering (in 2015-2016, those careers were: Environmental work, biology or zoology, mathematics, computer science, and engineering). The C-STEM students' responses were substantially higher than a comparison group of students who participated in a range of classroom-based and informal STEM programs: Among the latter group of students, the most popular career was veterinary science, which 51.4% of students indicated they were "interested" or "very interested" in (Faber et al., 2013)

Table 21. Elementary student career interests

Career Interest	Average response	Not at all interested	Not so interested	Interested	Very Interested
Physics	2.75	14.0%	15.8%	50.9%	19.3%
Environmental Work	2.89	5.3%	22.8%	49.1%	22.8%
Biology or Zoology	2.82	12.3%	22.8%	35.1%	29.8%
Veterinary Science	2.95	7.0%	29.8%	24.6%	38.6%
Mathematics	2.93	7.0%	26.3%	33.3%	33.3%
Medicine	3.02	12.3%	10.5%	40.4%	36.8%
Earth Science	2.96	7.0%	17.5%	47.4%	28.1%
Computer Science	3.09	10.5%	14.0%	31.6%	43.9%
Medical Science	2.67	15.8%	26.3%	33.3%	24.6%
Chemistry	2.91	14.0%	17.5%	31.6%	36.8%
Energy	2.70	10.5%	29.8%	38.6%	21.1%
Engineering	3.12	3.5%	19.3%	38.6%	38.6%

The secondary students were asked to respond to the same questions about the same STEM and STEM-related careers (Table 20). The secondary students' responses were slightly lower than the elementary students' responses, a decline that is consistent with research that suggests that students lose interest in STEM as they move through middle school and into high school (e.g., Bennett & Hogarth, 2009; Murphy & Beggs 2005).[3]

In 2015-2016, according to the average responses, the most popular careers were engineering and energy. In 2016-2017, the most popular career still was engineering (M = 3.04), though the mean response had declined somewhat, but the next most popular career was mathematics. Energy, though still popular, had dropped below medicine (M = 2.88), environmental work (M = 2.85), and computer science (M = 2.81). In 2015-2016, it was suggested that these two careers might be most popular in part because so many students were from Houston, where energy and engineering jobs historically have been plentiful. In 2016-2017, however, there were relatively more students from outside of Houston, and the energy industry within Houston has been contracting due to low global oil prices. Among the lowest rated careers were veterinary science (M = 2.64), chemistry (M = 2.50), and earth science (M = 2.49); veterinary science was the lowest rated career in 2015-2016, while the other two careers declined in popularity from one year to the next. In general, though, the students continue to express relatively high levels of interest in all of the STEM careers.

Table 22. Secondary student career interests

Career Interest	Average response	Not at all interested	Not so interested	Interested	Very Interested
Physics	2.69	12.5%	25.0%	43.8%	18.8%
Environmental Work	2.85	5.0%	25.0%	50.0%	20.0%
Biology or Zoology	2.73	13.8%	25.0%	36.3%	25.0%
Veterinary Science	2.64	13.8%	26.3%	42.5%	17.5%
Mathematics	2.95	8.8%	18.8%	41.3%	31.3%
Medicine	2.88	10.0%	26.3%	30.0%	33.8%
Earth Science	2.49	17.5%	33.8%	31.3%	17.5%
Computer Science	2.81	13.8%	25.0%	27.5%	33.8%
Medical Science	2.73	16.3%	22.5%	33.8%	27.5%
Chemistry	2.50	16.3%	31.3%	38.8%	13.8%
Energy	2.75	11.3%	22.5%	46.3%	20.0%
Engineering	3.05	6.3%	18.8%	38.8%	36.3%

Relationships Across Groups. In order to explore relationships in students' responses across different groups, the data were disaggregated further according to student sex, race/ethnicity,

[3] Research points to several reasons for why females lose interest in STEM as they progress through school, including masculine stereotypes about STEM, parents' expectations of their daughters, peer norms, and a lack of fit with personal goals (Dasgupta & Stout, 2014). Among students of both sexes, research points to teachers as playing an important role in shaping students' attitudes towards STEM (e.g., Cerini, Murray, & Reiss, 2004; Osborne & Collins, 2001). More recent research also suggests that the decline in interest in STEM and STEM careers also can be attributed to students' perceptions that science careers are boring, that science causes problems, and that scientists make too many compromises (Bennett & Hogarth, 2009).

and according to the kinds of STEM programs students had participated in prior to their most recent experience with C-STEM. Four analyses were conducted: A *t* test to examine whether there were differences in students' average responses to the questions within each of the two scales (engineering and 21st century skills) between males and females (see Table 18 above), an ANOVA to investigate differences in average scale scores across racial and ethnic groups, a *t* test to explore differences in the scales according to students' prior participation in STEM programs (C-STEM only vs. other STEM programs), and finally a Chi square test of association was used to explore relationships between each of the groups listed above and students' responses to the questions about their career interests. The tests were conducted using a significance level of $p<0.05$ and all tests were conducted separately for elementary and secondary students.

Elementary Students.
Differences in scales. Differences between males and females' index scores for the engineering and 21st century skills scales were examined using an independent samples *t* test. In order to conduct these tests, an index was created for each scale by averaging students' responses to the questions within each scale. In this way, each student had two index scores: One for engineering and one for 21st century skills. As continuous outcomes, each score could be utilized as a dependent variable in the two tests. Both indices had a minimum of 1 and a maximum of 5. The mean score for the engineering scale in 2016-2017 (M=3.97, SD=0.57) was slightly higher and had less variability than in 2015-2016 (M=3.86, SD = 0.78), and the mean score for the 21st century skills scale in 2016-2017 (M=4.13, SD=0.54) was similar to the score in 2015-2016 (M=4.15, SD = 0.63), which also was somewhat more variable.

The analysis suggests that there were no significant differences between elementary males and females. These results stand in contrast to those from 2015-2016, when the *t* test comparing scores for males vs. females indicated that the elementary males had significantly more positive perceptions of both engineering and their own 21st century skills than did the elementary females. The results from 2016-2017, then, are not consistent with previous research using the same instrument, which has found that females were less optimistic about their own capabilities in and had less positive attitudes toward engineering and technology (e.g., Unfried et al., 2014). This finding is notable and should be explored more deeply in future research on C-STEM.

For the purpose of the analysis of differences across racial and ethnic subgroups, the race/ethnicity variable was recoded into three categories: African American students, Latino students, and other students. The 'other students' included White, Asian, and Native American students, and the change was made because, on their own, the categories had too few students to meaningfully analyze the statistical differences. The two scales were compared across the three subgroups using ANOVA tests, and the results indicated that there were no differences for either scale across any of the subgroups.

Finally, differences in average scores for the two scales were compared across subgroups as defined by the students' prior participation in C-STEM. As there were too few responses for two of the four groups of experience with STEM (6-10 STEM programs and more than 10 programs), a second independent samples *t* test was conducted comparing scores across the two remaining groups: Only C-STEM and participation in any non-C-STEM STEM program. As was the case in 2015-2016, the test indicated that there were no significant differences between the two groups for either of the scales, which suggests that students who only had participated in C-STEM were just as positive about engineering and their own 21^{st} century skills as those students who had participated in other STEM programs.

Differences in career interests. The final analysis of the elementary student sample examined student interest in STEM and STEM-related careers. A Chi square test of association was utilized to examine whether there was a relationship between a student's sex, race/ethnicity, and prior STEM participation with his or her level of interest in different STEM-related careers. There were no significant associations between the career preferences expressed by the male vs. the female elementary students in the sample.

The same test was used to examine the relationship between students' race and ethnicity and their interest in the same STEM-related careers. The same three-category race variable described in the previous section was utilized again. As was the case with student sex, there were no significant relationships between career interest and student race/ethnicity.

Finally, a Chi square was used again to examine the relationship between prior experience with STEM and career interests. Based on this analysis, there were no significant relationships detected. This year's results stand in contrast to the results from the 2015-2016 administration, in which several significant differences emerged. Specifically, students who had no prior experience with C-STEM were more interested in the following STEM-related careers than students who only had prior experience with C-STEM: Environmental work, mathematics, medicine, medical science, chemistry, energy, and engineering.

As mentioned above, all of these elementary results should be interpreted with caution given that the majority of the elementary students responding were in second and third grades and the survey was intended for students in fourth and fifth grades.

Secondary Students.
Differences in scales. Similar analyses were conducted using the secondary student sample: The existence of differences in students' responses to the questions within each of the scales was explored using an independent samples *t* test and a one-way ANOVA. Also similar to the elementary analyses, the dependent variable was created by averaging students' responses to the items that made up each scale. The mean score for the engineering scale in 2016-2017 (M=3.96, SD=0.61) was similar but with more variability than it was in 2015-2016 (M=4.1, SD = 0.58), and the mean score for the 21^{st} century skills scale in 2016-2017 (M=4.14, SD=0.54) also was similar to the score in 2015-2016 (M=4.2, SD = 0.56). These averages also are similar to those observed for the elementary sample.

In the independent samples *t* test analysis, significant differences were found: Secondary males (M = 4.109, SD = 0.566) were more positive about engineering overall than the females [(M = 3.79, SD = 0.63), $t(78) = 2.37$, $p = 0.02$.], but not for the 21^{st} century skills scores. These results are similar to those for the elementary sample. Again, these differences were consistent with previous research using the same instrument (Unfried et al., 2014).

The two scales were compared across student racial/ethnic subgroups. Of the subgroups, 'two or more races' was dropped from the analysis because there was only one student identifying as such, which would not have allowed for meaningful comparison. The results of the one-way ANOVA analysis suggest that differences across groups for the engineering index were almost statistically significant (p=0.051). Specifically, Latino students' responses were higher than

African American students' responses ($F(3, 75) = 2.713$, $p = .051$). The other differences among groups were not significant.

Differences in students' average responses to the engineering and 21st century skills items also were explored according to their previous experience with STEM programs. The responses were collapsed into two categories: C-STEM only and other STEM programs. Therefore, a *t* test conducted. The results indicate that there were no significant differences in engineering or 21st century skills scores between the two groups, as was the case in the 2015-2016 school year.

Differences in career interests. A Chi square test of association was conducted to explore whether there was a relationship between different student subgroups and their career preferences (see Table 23 for a summary of results across all dimensions). The first test examined the relationship between students' sex and their career preferences. Unlike in the analysis of career interests among the elementary students, several relationships were found between sex and career interests among the secondary students. In 2016-2017 the male students were more interested in three careers: Physics [χ^2 (3, n = 80) = 8.278, p=0.041], computer science [χ^2 (3, n = 80) = 8.563, p=0.036], and engineering [χ^2 (3, n = 80) = 13.465, p=0.004]. These results were similar to the 2015-2016 results, in which the male secondary students were more interested than female secondary students in math, computer science, and engineering. For the other career options, there were no significant associations.

Significant differences in career interests emerged among student racial/ethnic subgroups. African American and Latino students had relatively higher interest in environmental work compared to White students [χ^2 (9, n = 79) = 24.097, p=0.004]. The same was true for biology and zoology [χ^2 (9, n = 79) = 17.910, p=0.036]. The Latino and African American participants were more interested in medical science compared to Asian students [χ^2 (9, n = 79) = 19.883, p=0.019]. No other relationships were found.

To test whether there was a significant difference in students' career interests based on their prior experience with STEM programs, the secondary sample was divided into two groups: Students with no prior C-STEM experience and those with prior C-STEM experience. Then, a Chi square test was conducted. There were no significant relationships, which stands in contrast to the 2015-2016 administration, when one significant relationship emerged for energy careers. Specifically, in 2015-2016, students with no prior C-STEM experience were significantly more interested in energy careers than students with C-STEM experience only.

Table 23. Summary of subgroup comparisons for career interests for secondary students

Career	Sex	Race	Prior STEM
Physics	Y*	N	N
Environmental work	N	Y*	N
Biology and zoology	N	Y*	N
Veterinary work	N	N	N
Mathematics	N	N	N
Medicine	N	N	N
Earth science	N	N	N
Computer science	Y*	N	N
Medical science	N	Y*	N
Chemistry	N	N	N
Energy	N	N	N
Engineering	Y*	N	N

Note. * indicates significant at $p < 0.05$

Teacher Survey Results

In addition to surveying the students who participated in C-STEM during the 2016-2017 school year, the teachers who led the C-STEM sessions also received a survey. In total, 48 teachers participated in C-STEM, and 29 responded to the survey for a response rate of 60%, which is relatively high. The survey asked about the teachers themselves, their students, the way they implemented C-STEM, and about how well prepared they felt by the C-STEM professional development.

Teacher Demographics

The teachers leading C-STEM sessions are as diverse as the students they worked with. Of the teachers who responded to the survey, almost 90% were female (Table 24), almost 50% were African American, 17.2% were Latino, 24.1% were White, 6.9% were Native American, and 3.4% were Asian (Table 25). The percentage of African American teachers participating in C-STEM is very high given that the vast majority of teachers nationally (82.7%) continues to be White, and in 2012 only 6.4% of teachers were African American and 8% were Latino (Ingersoll & Merrill, 2017). Nationally, then, minority teachers are underrepresented when we consider the demographic breakdown of students in the public school system, and C-STEM as an organization is reaching and supporting teachers who are much more diverse compared to these national averages (Ingersoll, 2017).

Table 24. Teacher sex

	Frequency	Percent
Male	3	10.3%
Female	26	89.7%
Total	29	100%

Table 25. Teacher race

	Frequency	Percent
African American	14	48.3%
White	7	24.1%
Native American	2	6.9%
Latino	5	17.2%
Asian	1	3.4%
Total	29	100%

The teachers hailed from 15 schools and programs across the four states where there was C-STEM participation (Table 26). The schools with the greatest number of participating teachers according to the survey were Paul Robeson Malcolm X in Detroit, the Beatrice Mayes Institute in Houston, and Holy Redeemer in Milwaukee.

Table 26. Schools where teachers teach

School Name	Frequency	Percent
Beatrice Mayes Institute	3	10%
DEPSA	1	3%
Energy Institute	1	3%
Francone ES	2	7%
Gregg ES	1	3%
Hamilton MS	1	3%
Holy Redeemer	3	10%
Killough MS	1	3%
Paul Robeson Malcolm X	4	14%
Ross Elementary	1	3%
Sharpstown International HS	1	3%
Southwest Schools	2	7%
The Phoenix School	1	3%
Windsor Village ES	1	3%
Young Coggs	1	3%
Missing	5	17.24%
Total	29	100%

Most teachers were at an elementary school, with a quarter teaching middle school, and a fifth teaching high school (Table 27).

Table 27. Grade levels taught

Grade levels	Percent
Grades K-5	55.2%
Grades 6-8	24.1%
Grades 9-12	20.7%
Total	100

The teachers were asked to describe the achievement level of their students (Table 28). Just over a third responded that their students comprised mostly high achievers, just under a third responded that their students were mostly average achievers, while a quarter of teachers described their students as being at a mixture of levels. Only 3.4% of the teachers described their students as mostly low achievers.

Table 28. Which of the following best describes the prior STEM achievement levels of the students in this class/afterschool program relative to other students in this school?

	Frequency	Percent
Missing	2	6.9%
A mixture of levels	7	24.1%
Mostly average achievers	9	31%
Mostly high achievers	10	34.5%
Mostly low achievers	1	3.4%
Total	29	100

Teachers' STEM preparation

The survey also asked about how the teachers were prepared to teach STEM subjects. As is depicted in Table 29, almost 45% of teachers received their teaching certificate as part of a master's degree. One quarter of teachers received their certificate as part of their undergraduate degree, and one fifth of teachers received it after having finished their undergraduate degree. Finally, just under 7% of the teachers responded that they did not have any formal preparation to teach.

Table 29. Teachers' certification pathway

	Frequency	Percent
Missing	1	3.4%
A master's program that also awarded a teaching credential	13	44.8%
A post-baccalaureate credentialing program (no master's degree awarded)	6	20.7%
An undergraduate program leading to a bachelor's degree and a teaching credential	7	24.1%
You do not have any formal teacher preparation	2	6.9%
Total	29	100

The survey also asked about the less formal ways in which the teachers keep active in the broader STEM community. Just under a third (31%) of the teachers responded that in the last year they had participated in a professional learning community/lesson study/teacher study group focused on STEM or STEM teaching. These opportunities are external to C-STEM. Just over a quarter (27.6%) had participated in C-STEM's Integrated STEM Teacher Training webinars, chat sessions, listened to STEMcast podcasts, or completed asynchronous training on-line. These options include C-STEM's online training and resources. Finally, the smallest proportion of teachers (3.4%) responded have attended a national, state, or regional STEM teacher association meeting.

Table 30. In the last year, have you…?

	Frequency	Percent
Missing	3	10.3%
Attended a national, state, or regional STEM teacher association meeting?	1	3.4%
Participated in a professional learning community/lesson study/teacher study group focused on STEM or STEM teaching?	9	31%
Participated in C-STEM Integrated STEM Teacher Training webinars, chat sessions, listened to STEMcast podcasts, or completed asynchronous training on-line	8	27.6%
Total	29	100

Finally, the survey asked the teachers how frequently they taught STEM (Table 30). From the question, it is not clear whether this refers to any of the STEM subjects, or only some of them. There is quite a spread in terms of how frequently the teachers are teaching STEM, from some but not all weeks to almost every day, every week. Over a third of the teachers responded that they taught STEM every week, but not every day. Just over a quarter responded that they also taught STEM every week, and almost every day. Just under a quarter of the teachers responded that they do not teach STEM as a class or afterschool program, but as an afterschool enrichment program. Finally, 13.8% of the teachers responded that they do not teach STEM every week.

Table 30. Frequency of teachers' STEM teaching

	Frequency	Percent
I teach STEM all or most days, every week of the year	8	27.6%
I teach STEM every week, but typically three or fewer days each week	10	34.5%
I teach STEM some weeks, but typically not every week	4	13.8%
I do not teach STEM as a class/afterschool program, but as afterschool enrichment	7	24.1%
Total	29	100

Teachers' implementation of C-STEM

The following results address how the teacher respondents implemented C-STEM during the 2016-2017 school year. C-STEM is unique in that it allows a great deal of flexibility for its teachers to implement the program as works best for their school and classrooms. As a result, there is variability in how C-STEM is implemented. As Table 31 depicts, just over 40% of the teachers implemented C-STEM two days a week, and a quarter only once a week. Under a third of teachers implemented the program three or more days a week: Just under 14% each implemented it three or five days a week, and 3.4% implemented it four days a week.

Compared to similar after school programs, C-STEM is implemented, on average, more times per week. For example, the after school STEM program run by the Children's Museum of Houston meets once a week, which is typical of after school programs. On the other end of the scale are programs such as the St. Elmo Brady Academy, a STEM program run out of the University of Houston, which meets three times a week, a configuration that is less common.

Table 31. Number of days per week teacher implements C-STEM

	Frequency	Percent
1 day	8	27.6
2 days	12	41.4
3 days	4	13.8
4 days	1	3.4
5 days	4	13.8
Total	29	100

According to the teachers, student attendance during most weekly C-STEM sessions ranged from 5-10 students (Table 32). A quarter of the teachers reported that their weekly sessions included between 11 and 20 students, and 17.2% of teachers reported that they had more than 40 students participating. Very few reported having between 21 and 30 students (6.9%), or 31 to 40 students (3.4%). Unfortunately, the question does not clarify the particular configuration of the sessions, so it is not clear whether all of the students were working together or perhaps were broken down into groups. This question is particularly important for those teachers who reported their typical weekly sessions had more than 40 students.

Table 32. Number of students participating in C-STEM in a typical week

	Frequency	Percent
5-10	14	48.3
11-20	7	24.1
21-30	2	6.9
31-40	1	3.4
More than 40	5	17.2
Total	29	100

In addition to the weekly frequency of C-STEM meetings, the survey also asked about the amount of time students spend participating in C-STEM (Table 33). A majority of the teachers reported that their students spent at least 50% of their time (either class time or afterschool program time) participating in C-STEM over the course of the year: Just over 20% reported 50 to 74% of the time, just under a quarter reported that 75 to 90% of their time was dedicated to C-STEM, and 10% reported that over 90% of their time was taken up by C-STEM. Only a small percentage of the teachers (13.8%) reported that less than 25% of time was dedicated to C-STEM.

Table 33. Over the course of the school year, approximately what percentage of the C-STEM instructional time will students in this class/afterschool program spend in this program?

	Frequency	Percent
Missing	2	6.9%
Less than 25%	4	13.8%
25–49%	7	24.1%
50–74%	6	20.7%
75–90%	7	24.1%
More than 90%	3	10.3%
Total	29	100%

Teachers have a fair amount of flexibility regarding how they implement their selection of the C-STEM curriculum. In 2016-2017, C-STEM offered a total of eight modules, but the teachers register only for those modules they are interested in leading. For example, a teacher may only register for robotics and mural. These figures do *not* mean, then, that the modules teachers did register for were not completed in full. It is in this context that the next item should be interpreted. According to the teachers, only a small percent of students (6.9%) engaged with more than 90% of the eight modules, while almost 50% of the students engaged with less than 50% of the eight modules (Table 34). Almost one quarter of the teachers reported that their students used fewer than 25% of the modules, and a fifth used between 25% and 49% of the modules. Almost a third engaged with fifty to 74% of the modules, but only 10.3% engaged with 75% to 90%.

Table 34. Approximately what percentage of the module(s) in the C-STEM program will students in this class/afterschool program engage with during the school year?

	Frequency	Percent
Missing	2	6.9%
Less than 25%	7	24.1%
25–49%	6	20.7%
50–74%	9	31%
75–90%	3	10.3%
More than 90%	2	6.9%
Total	29	100%

Finally, the survey asked about the teachers' experiences with the kits that C-STEM provides (Table 35). In general, the teachers responded that the kits were less than adequate: A fifth responded in the lowest category, 'not adequate', and another 40% responded in the next two categories. Only a third of teachers thought the kits were somewhat adequate or adequate. It should be noted that the computer programming and debate modules did not come with a kit but rather a resource guide that directed teachers to online resources and videos. This might help explain why some teachers did not perceive the kits to be adequate.

Table 35. Considering the C-STEM tool-kits you are provided, how adequate are they for teaching this STEM class/afterschool program?

	Frequency	Percent
Not adequate	6	20.7%
Not quite adequate	4	13.8%
Middle option	8	27.6%
Somewhat adequate	6	20.7%
Adequate	4	13.8%
Missing	1	3.4%
Total	29	100%

Teachers' experiences with C-STEM professional development

In addition to the curriculum and kits, C-STEM provides professional development for the teachers who lead the program at their schools. Table 36 presents results from the questions about how well the C-STEM professional development had prepared the teachers. The responses are percentages; the percentages do not add up to 100% because of missing data.

Overall, the teachers felt prepared to teach C-STEM with diverse students. Those items that stand out for being particularly highly rated (i.e., over 50% of teachers responding felt they either were prepared or very well prepared) include:

- Learning how to use hands-on activities/manipulatives for STEM instruction (~55%),
- Implementing the C-STEM program to be used in your class/afterschool program (~60%),
- Assessing student understanding of STEM at the conclusion of instruction on a topic (~55%),
- Planning instruction so students at different levels of achievement can increase their understanding of the ideas targeted in each activity (~55%),
- Teaching STEM to English language learners (~50%),
- Encouraging students' interest in STEM (~70%),
- Encouraging participation of females in STEM (~70%),
- Encouraging participation of racial or ethnic minorities in STEM (70%),
- Encouraging participation of low income students in STEM (70%).

There were a few areas in which the teachers felt relatively less prepared, though it should be noted that there were very few negative responses. Areas where teachers felt somewhat less prepared include (i.e., over 20% of teachers indicating that they felt they were not adequately prepared or were only somewhat adequately prepared):

- Deepening your own STEM content knowledge (~25%),
- Learning how to use hands-on activities/manipulatives for STEM instruction (~25%),
- Learning about difficulties that students may have with particular STEM ideas and procedures (~38%),
- Teaching STEM to students who have learning disabilities (~27%)
- Teaching STEM to students who have physical disabilities (~20%)
- Teaching STEM to English-language learners (~25%)

In short, the teachers felt prepared to plan instruction and to assess after instruction, and they also felt prepared to encourage their students. They felt less prepared in terms of their own content knowledge and teaching students with special learning needs.

Table 36. How well the C-STEM professional development prepared teachers to…

	Not adequately prepared	Somewhat adequately prepared	Middle option	Prepared	Very well prepared
Deepening your own STEM content knowledge	10.3	13.8	27.6	24.1	17.2
Learning how to use hands-on activities/manipulatives for STEM instruction	3.4	20.7	13.8	27.6	31
Learning about difficulties that students may have with particular STEM ideas and procedures	27.6	10.3	27.6	27.6	6.9
Implementing the C-STEM program to be used in your class/afterschool program	6.9	6.9	20.7	34.5	24.1
Assessing student understanding of STEM at the conclusion of instruction on a topic	3.4	20.7	10.3	34.5	24.1
Plan instruction so students at different levels of achievement can increase their understanding of the ideas targeted in each activity	6.9	6.9	24.1	27.6	27.6
Teach STEM to students who have learning disabilities	10.3	17.2	17.2	27.6	20.7
Teach STEM to students who have physical disabilities	10.3	10.3	27.6	20.7	17.2
Teach STEM to English-language learners	10.3	13.8	17.2	31	20.7
Encourage students' interest in STEM	3.4	6.9	10.3	27.6	44.8

Encourage participation of females in STEM	3.4	3.4	17.2	24.1	44.8
Encourage participation of racial or ethnic minorities in STEM	3.4	6.9	13.8	24.1	44.8
Encourage participation of low income students in STEM	3.4	6.9	13.8	24.1	48.3

Instruction during C-STEM

Four questions asked about the emphasis teachers placed on various areas as they taught C-STEM. The vast majority of teachers (>70%) placed lots or heavy emphasis on increasing students' interest in STEM. Just over 60% of the teachers placed lots or heavy emphasis on real-life applications of STEM, and on preparing students for further study in STEM. Importantly, very few teachers responded that they placed no or little emphasis on these areas.

For the final question regarding the amount of emphasis teachers placed on teaching test-taking skills and strategies, the responses were quite evenly distributed. Almost 18% of the teachers placed little to no emphasis on teaching test-taking skills/strategies, but the same percentage reported placing lots or heavy emphasis on teaching these skills.

Table 37. Emphasis during C-STEM instruction

	None	Little	Some	Lots	Heavy emphasis
Increasing students' interest in STEM	3.60%	0%	21.40%	39.30%	35.70%
Real-life applications of STEM	3.70%	7.40%	25.90%	22.20%	40.70%
Preparing for further study in STEM	3.60%	3.60%	32.10%	32.10%	28.60%
Learning test taking skills/strategies	17.90%	25%	21.40%	17.90%	17.90%

These questions are important in large part because they touch on C-STEM's mission, notably raising students' interest in STEM, providing them with authentic learning experiences, and preparing them to enter the STEM pipeline. It is positive, therefore, that teachers seem to understand and work toward those goals in their own classrooms. It also is somewhat disheartening to hear from teachers that so many utilize their C-STEM time to work on test-taking strategies.

Technology use during C-STEM

One of C-STEM's goals is to make students technologically proficient. It is appropriate, then, to ask the teachers about the use of technology during their C-STEM sessions. Table 38 depicts teachers' responses regarding use of different kinds of technology. As is clear, there is a relatively wide range of frequency of use across all three types of technology. Personal computers or laptops were used less frequently than the internet or mobile phones (25% reported using them never or rarely), and the internet was reported as used most frequently (over 70% of the time). What's more, no teachers reported never using the internet. Personal computers or laptops were used by more teachers, more frequently than mobile phones, and over 35% of the teachers reported that their students use mobile phones either never or rarely.

Table 38. Frequency with which students the following technology during the C-STEM class/afterschool program

	Never	Rarely	Sometimes	Often	All or most of the time
Personal computers, including laptops	3.60%	21.40%	14.30%	35.70%	25%
The internet	0%	14.30%	14.30%	35.70%	35.70%
Mobile phones	11.10%	25.90%	11.10%	25.90%	25.90%

Connecting Program Implementation to Student Outcomes

In this section, school-level implementation is connected to student outcomes. This analysis provides more insight into how the ways in which teachers implement C-STEM relate to students' attitudes toward STEM and STEM-related careers. In order to examine implementation and outcomes, all teacher and student responses were aggregated to the school level to obtain mean values. Then, teacher and student files were merged, one for the elementary schools and one for the secondary schools. Because of the small sample sizes within each school, all analyses are descriptive.

It is important to note that the analysis is limited in several ways and should be read with those limitations in mind. The first limitation is that this analysis is descriptive and does not control for any other potential explanations for any differences observed. For this reason, no differences in student outcomes can be attributed to the level of implementation. Second, most of the schools did not have data for more than one teacher, and in those cases the implementation data represent the responses of only one teacher; if another teacher at the same school also participated in C-STEM but did not respond to the survey, any differences in teaching or implementation would not be reflected. A third limitation is that there is not a perfect overlap between the schools represented in the student and the teacher data. Despite those limitations, examining the associations between implementation and outcomes is key to beginning to understand the effect of the program and to thinking about program improvement.

Elementary schools

Program implementation. The three elementary schools for which there were overlapping teacher and student data were: Holy Redeemer Christian Academy, Windsor Village Elementary School, and Betsy Ross Elementary School. Among the three schools, there was quite a bit of variation on all of the implementation measures (Table 39). In terms of dosage, which refers to the amount of the intervention that students were exposed to, the teachers from Holy Redeemer, a private school, responded that, in a typical week, they taught C-STEM four days a week. In contrast, the two public elementary schools taught C-STEM one day a week each. On other measures of dosage, percent of instruction time for C-STEM and percent of C-STEM modules in which students engaged, the teachers at Holy Redeemer also reported higher dosage than the teacher(s) at Ross; there was no data for Windsor Village. Overall, then, Holy Redeemer could be considered to have higher levels of dosage than either of the two other schools.

Another dimension of implementation measured by the survey questions is quality. C-STEM is meant to be inquiry-based and hands-on, with a focus on having students address real-world problems. The questions about the amount of emphasis that the teachers place on different goals get at this dimension. According to the responses from the teachers at Holy Redeemer, they had the highest quality implementation. They reported placing heavy emphasis on real-life applications, on increasing students' interest in STEM, on encouraging further study in STEM, and, interestingly, on test-taking skills and strategies. The other two schools reported somewhat lower quality implementation. At Ross, the teacher(s) reported slightly less emphasis on the first three, and much less emphasis ('rarely') on test-taking skills and strategies. Finally, the teacher(s) at Windsor Village reported less emphasis on the first three items compared to teachers at the other two schools, and levels of emphasis on test-taking skills comparable to Ross.

A final set of questions about implementation relates to C-STEM's goal to help students become proficient users of technology. According to the teachers' responses, students at Holy Redeemer use laptops or personal computers as well as the internet more frequently than students at the two other schools. Students' use of mobile phones was relatively similar across all three schools.

Table 39. School-level implementation (values are means)

	Holy Redeemer	Windsor Village	Ross
Prior level of achievement of students	2.67	2	3
Number of days in a typical week C-STEM was implemented	4	1	1
Emphasis on real-life applications	5	3	4
Emphasis on increasing students' interest in STEM	5	3	5
Emphasis on encouraging further study in STEM	5	3	4
Emphasis on test-taking skills & strategies	4.67	2	2
Percent of instruction time for C-STEM	2.67	-	1
Percent of modules in which students engaged	2.67	-	1
Use of laptop/PC	4	1	3
Use of internet	5	2	3
Use of mobile phones	3	3	2

In summary, then, Holy Redeemer could be considered a 'high' implementation campus because the ratings were high for dosage, quality of implementation, and technology use. Betsy Ross Elementary school would rate slightly higher than Windsor Village because of the differences in emphasis during instruction and because of somewhat higher technology use.

Student outcomes. In this section, several key student outcomes are compared across the three elementary schools. Holy Redeemer's students have attitudes that overall are somewhat higher than the students at the other two schools, though there are some exceptions. Importantly, it is not possible to attribute any differences to C-STEM implementation levels at any of the schools.

The areas compared here included students' general interest in STEM careers, the support they perceive from their parents for STEM, their perception of their own abilities in STEM, and their scores for the engineering and 21st century skills indices. For the first question about interest in STEM careers, students at Ross expressed the most interest, and those at Windsor Village expressed the least. Students at Holy Redeemer perceived slightly more parental support for STEM than those at Ross (it is not surprising that parents at a private school would seem or be more involved in their children's education), and Windsor Village students again had much different perceptions. Students at Ross elementary were the least negative about their math abilities, and relatively positive about taking advanced math. Interestingly, students at

Holy Redeemer were the most negative about their ability in math and their potential to take future advanced math. They also were the most negative about their science ability, while students at Windsor Village were the least negative. In terms of their judgment of their potential to take advanced mathematics and science courses in the future, students at Holy Redeemer rated themselves the highest, while students at Ross rated themselves the lowest. There were no meaningful differences in intentions to go to college across the three schools.

Finally, average student scores for the two indices were compared across the schools. In contrast to the previous items, students from Holy Redeemer rated themselves lower than students at Ross elementary on the engineering index, and lower than both public elementary schools for the 21st century skills index. Ross students rated themselves the highest for the engineering index, and Windsor Village rated themselves the highest for the 21st century skills index.

Table 40. Elementary student outcomes

	Holy Redeemer	Windsor Village	Ross
Interest in STEM careers	0.77	0.17	0.90
Parental support for STEM	0.92	0.17	0.90
Bad at math	2.62	2.50	2.19
Potential to take advanced math	3.62	4.50	3.90
Bad at science	2.92	2.50	2.52
Future advanced math courses	1.85	1.83	1.48
Future advanced science courses	2.08	2.00	1.48
Intention to attend college	1.00	1.00	1.10
Engineering index	3.74	3.65	4.11
21st century skills index	4.00	4.45	4.32

In contrast to how the schools stacked up in terms of teachers' reporting of implementation of C-STEM, students' attitudes relating to STEM were much less consistent across schools. On the whole, students at Holy Redeemer are somewhat more positive than students at the other two schools. It is not possible to say, however, that the differences observed are because of C-STEM implementation, particularly given that Holy Redeemer is a private school. Nonetheless, it is useful to parse out the differences across schools.

Secondary schools

Program Implementation. The five secondary schools for which there were overlapping teacher and student data were: Hamilton Middle School, Killough Middle School, Young Coggs High School, Sharpstown International High School, and the Energy Institute High School. Among the five schools, there was quite a bit of variation on several of the implementation measures (Table 41). In terms of dosage, the teachers at Sharpstown International HS reported implementing C-STEM five days a week in a typical week. In contrast, teachers at the Energy Institute reported implementing the program only one day a week. The other schools were in the middle. The other two dosage measures indicated a similar range. For both measures, percent of instruction time for C-STEM and percent of C-STEM modules completed, Killough MS and Young Coggs HS ranked the lowest with less than 25% of time and of modules. Hamilton MS ranked the highest on both, with more than 90% of instruction time for C-STEM and 75 to 90% of modules completed. The other two schools, Sharpstown International and the Energy Institute ranking in the middle, with the latter scoring lower than the former.

In terms of the quality of implementation, there were four measures, and overall less variability than with the dosage variables. Teachers reported consistently high levels of quality vis-à-vis their emphasis on real-life application, on increasing students' interest in STEM, and encouraging further study in STEM. The exception to this consistency was the final quality measure, emphasis on test-taking strategies and skills. Teachers at the Energy Institute reported emphasizing this the least, while Sharpstown International HS teachers reported placing a great deal of emphasis on these skills. The other three schools were in the middle.

Finally, in terms of technology use, teachers from across the five schools reported high levels of use of laptops or PCs, the internet, and mobile phones.

In summary, program implementation was relatively consistent and high across the five schools. Sharpstown International teachers implemented C-STEM with the greatest frequency, but their students engaged with relatively few modules. Quality at Sharpstown International was high except that the teachers there reported the most emphasis on test-taking skills. The Energy Institute, Young Coggs HS, and Killough MS had relatively low frequency but high quality of implementation. Finally, Hamilton MS had implementation levels and quality consistently in the middle to high middle. In short, it is difficult to point to a 'highest' implementer.

Table 41. School-level implementation

	Hamilton MS	Killough MS	Young Coggs HS	Sharpstown International HS	Energy Institute HS
Number of days in a typical week C-STEM was implemented	3	2	2	5	1
Emphasis on real-life applications	4	5	5	5	5
Emphasis on increasing students' interest in STEM	4	5	4	5	4
Emphasis on encouraging further study in STEM	3	5	5	5	4
Emphasis on test-taking skills & strategies	2	3	3	4	1
Percent of instruction time for C-STEM	4	0	0	3	1
Percent of modules in which students engaged	3	0	0	2	1
Use of laptop/PC	4	4	4	5	5
Use of internet	5	4	4	5	5

Use of mobile phones	5	4	4	5	5

Student outcomes. In this section, several key student outcomes are compared across the three high schools and two middle schools. According to the teachers, most of the students were low or mixed achievers in the STEM areas.

The areas compared here included students' general interest in STEM careers, the support they perceive from their parents for STEM, their perception of their own abilities in STEM, and their scores for the engineering and 21st century skills indices. Across all five schools, the students reported being interested in STEM careers generally. There was more variation in terms of the support students perceived from their parents: All students at Hamilton MS responded that their parents supported STEM, while only 50% of students at Young Coggs HS perceived that the parents supported STEM. The other three schools were in middle.

Students across all five schools were not very positive about their abilities in mathematics and science. With the lowest score being 1 and the highest score being 5, the schools ranged from a low of 1.91 (Sharpstown International) to a high of 3 (Young Coggs) for mathematics, and a low of 1.36 (Killough) to a high of 2.5 (Hamilton and Young Coggs). In other words, the low scores were quite low, and the high scores still only were in the middle of the range. Students at Young Coggs were the most positive among the schools for both mathematics and science.

Across all five schools, the students either were sure they would or were unsure whether they would take advanced mathematics or science courses, or attend college. Students at Hamilton and Young Coggs were the least sure about both future advanced mathematics and science courses. Almost all of the students responded that they were sure they would attend college.

Finally, there were some differences in students' average scores for the engineering and 21st century skills indices. Students at Hamilton scored the highest for the engineering index, and students at Killough MS scored the lowest. For the 21st century skills index, students at the Energy Institute scored the highest and students at Hamilton scored the lowest.

Table 42. Secondary student outcomes

	Hamilton MS	Killough MS	Young Coggs HS	Sharpstown International HS	Energy Institute HS
Prior STEM achievement	1.50	1.64	1.00	1.00	1.71
Interest in STEM careers	1.00	1.00	1.00	0.82	1.00
Parental support for STEM	1.00	0.82	0.50	0.82	0.75
Bad at math	2.50	2.27	3.00	1.91	2.38
Potential to take advanced math	4.00	3.82	3.25	4.00	4.00
Bad at science	2.50	1.36	2.50	2.36	1.88
Future advanced math courses	1.00	1.55	1.00	1.73	1.50
Future advanced science courses	1.50	1.91	1.50	1.64	1.63

Intention to attend college	2.00	1.91	2.00	2.00	2.00
Engineering index	4.22	3.97	4.06	4.16	4.08
21st century skills index	4.02	4.16	4.16	4.09	4.51

As with the elementary schools, it is impossible to attribute C-STEM implementation to student outcomes. Unlike with the elementary schools, however, it is difficult to even discern a pattern among the secondary schools. The implication is that it is unlikely that there is a relationship between C-STEM implementation in the 2016-2017 school year and students' attitudes towards STEM.

Comparison to Previous Years

In this section, student results from the 2016-2017 survey administration will be compared systematically to those from the 2015-2016 administration of the same survey. Comparisons between responses from 2015-2016 and the two prior years (2013-2014 and 2014-2015) are discussed in the 2016 C-STEM evaluation and will not be repeated here. In those two years, C-STEM surveyed its students and teachers using two separate instruments. Results from the 2016-2017 teacher survey will be compared, where possible, to those from 2014-2015.

Aggregate student results in the following areas will be compared: Student demographics, STEM dispositions, interest in STEM careers, perception of support, and exposure to and opportunities in STEM. After that, subgroup differences across the two years will be discussed. Finally, teacher responses will be compared. When reading these comparisons, it is important to remember that the responses from year to year are not necessarily from the same students. Therefore, the comparison is not perfect and does not necessarily indicate *changes* in students' attitudes.

For the teachers, only demographics will be compared as the instruments do not otherwise overlap.

Students' STEM Dispositions

Overall, the students who responded to the survey in 2016-2017 were slightly more positive about STEM than the students who responded in 2015-2016, but this may be because the elementary students were more positive in 2016-2017 than were the secondary students. Beginning with students' beliefs about their own ability in mathematics and science (Table 39), students in 2015-2016 were somewhat more positive about their abilities than the students in this most recent year. This was true for elementary and secondary students, except in the case of the secondary students' responses to their ability science in 2015-2016, which was lower than the more recent assessment.

Table 39. Comparison of student dispositions in science and mathematics

	2015-2016		2016-2017	
	Elementary	Secondary	Elementary	Secondary
I can handle most subjects well, but I'm bad at math	2.66	2.23	2.14	2.53
I'm sure I could do advanced math work	3.91	3.87	4.16	3.68
I can handle most subjects, but I can't do well in science	2.94	2.03	2.42	2.16

Table 40 compares students' expectations in mathematics, English language arts (ELA), and science. For secondary ELA and mathematics, the 2015-2016 responses were positive, though for secondary science, the more recent responses were more positive. For the elementary students, fewer students in 2016-2017 expected to do very well in ELA and mathematics, but more students in 2016-2017 expected to do OK/pretty well in ELA and mathematics. For elementary science, a larger proportion of students in 2016-2017 expected to do very well and not very well as compared to the students in 2015-2016, proportionately more of whom responded, OK/Pretty well.

Table 40. Comparison of students' expectations in mathematics, English language arts, and science

	Not very well	OK/Pretty well	Very well
	16-17/15-16	16-17/15-16	16-17/15-16
Secondary ELA	1.3%/0.9%	45%/44%	53.8%/55.2%
Secondary Mathematics	7.5%/2.6%	36.3%/39.7%	56.3%/57.8%
Secondary Science	3.8%/3.4%	32.5%/37.9%	63.8%/58.6%
Elementary ELA	3.5%/4.6%	33.2%/30.8%	63.2%/64.6%
Elementary Mathematics	5.3%/4.6%	22.8%/27.7%	71.9%/67.7%
Elementary Science	1.8%/4.6%	24.6%/29.2%	73.7%/66.2%

When comparing average scores for the two indices (engineering and 21st century skills; Table 41), the 2015-2016 results were higher for both secondary and elementary students.

Table 41. Comparison of average student scores for engineering and 21st century skills

	2015-2016		2016-2017	
	Elementary	Secondary	Elementary	Secondary
Engineering Index	3.86	4.09	3.96	3.96
21st Century Skills Index	4.15	4.23	4.13	4.13

Finally, Table 42 compares students' intentions regarding mathematics and science courses, as well as their intentions to attend college. Focusing first on mathematics, more secondary students in 2016-2017 did not think they would take advanced mathematics courses compared to 2015-2016. The opposite was true for the elementary students: Students in 2016-2017 were much more positive about taking future advanced mathematics than the students who responded in 2015-2016.

Moving on to science, more secondary students in 2016-2017 were unsure about taking future advanced science courses, and fewer students responded 'yes' compared to secondary students in 2015-2016. As with the mathematics results, the elementary students responding in 2016-2017 were more optimistic about their future course-taking in science than were the elementary students in 2015-2016, when more were unsure.

Finally, there were some differences in students' college intentions. Secondary students in 2016-2017 were more uncertain about attending college than were the students in 2015-2016. Again, the elementary students demonstrated the reverse pattern: Students in 2016-2017 were more optimistic and overall more certain than the students responding in 2015-2016.

In short, the students' responses reveal that the elementary students were more positive in their outlooks in 2016-2017 when compared to the elementary students in 2015-2016. The opposite was true for the secondary students, who overall were less optimistic in 2016-2017. Based on the data gathered, it is not clear why these differences emerged, or whether the differences are significant or practically meaningful.

Table 42. Comparison of students' intentions

	No	Not sure	Yes
	16-17/15-16	16-17/15-16	16-17/15-16
Secondary mathematics	15%/4.3%	25%/24.1%	60%/71.6%
Secondary science	11.3%/12.1%	27.5%/19.0%	61.3%/69.0%
Secondary college	1.3%/2.6%	7.5%/0.9%	91.3%/96.6%
Elementary mathematics	1.8%/12.3%	26.3%/29.2%	71.9%/58.5%
Elementary science	14.0%/13.8%	22.8%/30.8%	63.2%/55.4%
Elementary college	3.5%/3.1%	0%/7.7%	96.5%/89.2%

Students' Interest in STEM Careers

In this section, students' interest in STEM careers is compared between the two years. As is depicted in Table 43, a pattern similar to that observed in the students' intentions emerges, but only for the elementary students. Specifically, the elementary students expressed slightly higher interest in STEM careers in 2016-2017. In contrast to the secondary students' intentions regarding advanced STEM coursework and college, more secondary students expressed interest in STEM careers in 2016-2017 than in 2015-2016. This contrast with the previous items is interesting given that it might be assumed that students interested in STEM career also would be interested in STEM courses. Future research should explore this finding further.

Table 43. Comparison of students' interest in STEM careers

2015-2016	No	Yes
Elementary	21.50%	78.50%
Secondary	15.50%	84.50%
2016-2017		
Elementary	19.30%	80.70%
Secondary	10.00%	90.00%

Table 44 compares students' average responses regarding their interest in a set of STEM-related careers. Elementary students' responses were higher in 2016-2017 as compared to 2015-2016 for the following areas: Physics, environmental work, veterinary work, mathematics, medicine, earth science, computer science, chemistry, and engineering. It was lower in 2016-2017 in the following areas: Biology, medical science, and energy. In some cases, the differences were quite small and are unlikely to be statistically significant (i.e., environmental work and mathematics), while other differences were larger and might be statistically significant (i.e., physics, veterinary work, medicine, earth science, chemistry, and engineering)

Secondary students' responses were higher in 2016-2017 in the following areas: Physics (small difference), environmental work, biology and zoology (small difference), veterinary work, mathematics, medicine, and medical science. The secondary 2016-2017 responses were lower in the following areas: Earth science, computer science (small difference), chemistry (small difference), energy (small difference), and engineering. As with the elementary responses, some of the differences are larger than others, suggesting that potentially some of the differences are more meaningful than others.

Because the differences are not consistent across the elementary and secondary students, it is unlikely that the differences can be attributed to the different program focus between the two years. Future research should seek to unpack these differences.

Table 44. Comparison of aggregate responses for STEM-related career interests

	2015-2016		2016-2017	
	Elementary	Secondary	Elementary	Secondary
Physics	2.58	2.68	2.75	2.69
Environmental work	2.86	2.65	2.89	2.85
Biology and zoology	2.89	2.68	2.82	2.7
Veterinary work	2.62	2.38	2.95	2.64
Mathematics	2.92	2.76	2.93	2.95
Medicine	2.77	2.58	3.02	2.88
Earth science	2.72	2.71	2.96	2.49
Computer science	3.06	2.85	3.09	2.81
Medical science	2.71	2.59	2.67	2.73
Chemistry	2.77	2.57	2.91	2.5
Energy	2.83	2.81	2.7	2.75
Engineering	2.97	3.24	3.12	3.05

Students' Perception of Support

Students in both secondary and elementary grades perceived less parental support for STEM in 2016-2017 compared to the previous year. The difference is particularly pronounced for the secondary students given that less than a fifth in 2015-2016 believed their parents did not support them, and in 2016-2017 that had jumped to almost a quarter. The increase was present for the elementary students as well, but was not as large.

Table 45. Comparison of perception of parental support for STEM

2015-2016	No	Yes
Elementary	20%	80%
Secondary	17.20%	82.80%
2016-2017		
Elementary	24.60%	75.60%
Secondary	23.75%	76.25%

Opportunities in STEM for Students

The final section for which students' responses will be compared across the two years is the opportunities available for students in STEM. Table 46 describes students' prior participation in STEM program, including C-STEM. The most notable difference between the responses in the two years is that in 2016-2017, there was a larger percentage of elementary and secondary students who only had participated in C-STEM and reported not having participated in other STEM programs. This is important because, as mentioned above, this means that C-STEM is reaching a student population who otherwise are not being served by STEM enrichment programs.

Table 46. Comparison of students' prior participation in C-STEM programs

	2015-2016		2016-2017	
	Elementary	Secondary	Elementary	Secondary
1-5 STEM programs	30.80%	29.10%	19.30%	24.70%
6-10 STEM programs	3.10%	9.10%	1.80%	9.10%
More than 10 STEM program	1.50%	0.90%	0.00%	1.30%
Only C-STEM programs	56.90%	60.90%	75.40%	64.90%
Total	100%	100%	100%	100%

Table 47 describes students' interest in participating in future STEM programs. Both the elementary and secondary students expressed less interest in future STEM participation in 2016-2017 as compared to the students in 2015-2016. The difference was particularly pronounced among secondary students, where the percentage responding 'no' nearly doubled between the two years, from 5.2% to 10%.

Table 47. Comparison of students' interest in participating in future STEM programs

2015-2016	No	Yes
Elementary	13.80%	86.20%
Secondary	5.20%	94.80%
2016-2017		
Elementary	19.30%	80.70%
Secondary	10.00%	90.00%

Teacher Demographics

When compared to the 2014-2015 school year, there were more teachers from elementary grades in 2016-2017. There also appear to have been more teachers in 2014-2015 who taught more than one grade level as compared to 2016-2017. This likely is because C-STEM was implemented in more elementary schools in 2016-2017, but it also could be because of the structure of the survey itself, and whether teachers were allowed to choose more than one grade level option.

Table 48. Grade level distribution among teachers

Grade levels	2014-2015	2016-2017
Grades K-5	25%	55.2%
Grades 6-8	100%	24.1%
Grades 9-12	75%	20.7%
Total	-	100

Conclusion

In 2016-2017, a total of 1,440 students and 48 teachers from across four states and 19 schools and one mentoring program participated in C-STEM. Of these, 137 students and 29 teachers responded to the online survey. The survey utilized this past year measured students' interest in engineering, their perception of their own 21st century skills, their perception of their academic ability in science, mathematics, and in English language arts, and their interest in various STEM-related careers. The results suggest overall that the participating students were very positive about STEM, STEM careers, and their own performance and potential in STEM subjects. The results also point to some areas in which students were more positive than in the 2015-2016 school year, and others where they were somewhat less positive.

Key Findings

Student responses. The analyses reported on in this report produced several key findings, particularly when compared to results from the 2015-2016 year. Those results are summarized here.

Secondary males were more confident than secondary females about advanced math, as was the case in 2015-2016. The differences between the two years are positive as the secondary females overall were positive about STEM and their potential in STEM careers and coursework. There were no significant differences for elementary students in terms of race. Among secondary students, the African American and Latino students were more positive than the White and Asian students about their prospects in mathematics and advanced mathematics, though that relationship was reversed for science.

In terms of students' STEM participation, elementary students with previous C-STEM experience were more positive about their abilities in mathematics and advanced mathematics, in contrast to responses in the 2015-2016, when they were more negative. There were differences among secondary students. In terms of career interests, in 2016-2017, elementary and secondary students on average rated themselves as 'interested' in all of the careers, which was slightly higher than in the 2015-2016 administration. Importantly, the C-STEM students indicated they were more interested in STEM careers and in attending college compared to students who had participated in the 4-H Science Initiative.

When students' responses about their future participation in STEM education, their expectations, and the two scales were disaggregated by student sex, there only were differences among secondary students: More secondary males were confident about advanced math. This is an important finding because most research shows that girls are less positive about math compared to boys. Similarly, when comparing student responses across different racial groups, there only were significant differences among the secondary students. Contrary to conventional wisdom, the African American and Latino students were more positive than White and Asian students about their future participation in STEM and about their ability in mathematics. The White students were less positive than the other groups about their ability to complete advanced mathematics and about their performance in science. Overall, C-STEM students were more positive about engineering than similar students participating in other classroom-based or informal STEM programs

Finally, when the responses were disaggregated by C-STEM participation, proportionately more elementary students reported interest in participating in future STEM programs compared to students who had participated in one to five STEM programs. Elementary students who previously had participated in C-STEM only also were much more positive about their abilities in mathematics and advanced mathematics. Among the secondary students who only had participated previously in C-STEM, no significant relationships emerged.

In terms of the students' career interests, there were no significant associations between the career preferences expressed by the male vs. the female elementary students in the sample. There also were no significant relationships between career interest and student race/ethnicity, or between career interest and prior STEM experience among the elementary school students. Several relationships were found among the secondary students, including between males and females (males were more interested in physics, computer science, and engineering), and among racial/ethnic groups (African American and Latino students were more interested in environmental work, biology, and zoology compared to White students, and more interested in medical science compared to Asian students). No differences were detected according to prior STEM experience.

The report also presents results from a survey of C-STEM teachers. Twenty-nine teachers (60%) responded to a survey about themselves, their students, the way they implemented C-STEM, and about how well prepared they felt by the C-STEM professional development. C-STEM's teachers are very racially and ethnically diverse compared to national averages. Over half were from elementary schools and they reported teaching students over varying levels. Approximately a third of the teachers reported having participated in a professional learning community or study group, and just over a quarter reported participating in C-STEM's trainings.

Teacher responses. In terms of how the teachers implemented C-STEM, they reported implementing the program more often than comparable STEM programs. During this time, about half of the teachers implemented between 25% and 74% of the modules available to them. Moreover, just over 60% of the teachers reported placing lots or heavy emphasis on real-life applications of STEM, and on preparing students for further study in STEM. Finally, over half of the teachers reported using the internet, personal computers/laptops, and mobile phones often or most of the time.

C-STEM also provides professional learning opportunities to the teachers and, overall, the teachers felt prepared to teach C-STEM with diverse students. There were a few areas in which the teachers felt relatively less prepared, though it should be noted that there were very few negative responses.

Trends in implementation were linked to aggregate student responses. The analysis pointed to some differentiation among the elementary schools, with a private school emerging as a 'high' implementation and 'high' outcomes campus. Across the secondary campuses, program implementation was relatively consistent and high. There did not appear to be any systematic relationship, however, between implementation and student responses at the secondary level.

Comparison across years. Compared to previous years, the students who responded to the survey in 2015-2016 year were more positive about STEM than the students who responded in the 2016-2017. The elementary students were more positive in their outlooks in 2016-2017 when compared to the elementary students in 2015-2016, but the opposite was true for the secondary students, who overall were less optimistic in 2016-2017. The elementary students expressed slightly higher interest in STEM careers in 2016-2017. In contrast to the secondary students' intentions regarding advanced STEM coursework and college, more secondary students expressed interest in STEM careers in 2016-2017 than in 2015-2016. Finally, in 2016-2017, there was a larger percentage of elementary and secondary students who only had participated in C-STEM and reported not having participated in other STEM programs.

Comparison to other STEM programs. C-STEM compares very positively to other STEM programs. For example, when compared to students participating in other, similar STEM programs such as 4-H's Science Initiative, C-STEM students are as or more positive in their attitudes about STEM education and STEM careers. At the same time, C-STEM serves a uniquely diverse student and teacher population, reaching students who have little to no prior exposure to STEM learning and who are underrepresented in STEM education and STEM careers. These comparisons indicate that C-STEM is a strong program that is living up to its mission of cultivating the next generation of innovators and thought leaders, particularly among students who are underserved in our schools.

Recommendations

In this section, three types of recommendations are provided based on the findings described above. First, recommendations are provided for the teacher training. Then, recommendations for future research into interesting findings are presented. Finally, recommendations for changes to the design of any future evaluations are made.

Teacher training. The survey asked teachers to reflect on and rate their experiences with C-STEM. While teachers generally were positive about the support C-STEM provided them, there were two areas where they were less positive: Preparation and the quality of the kits C-STEM provides.

At least a fifth of teachers felt that C-STEM had not supported their acquisition of STEM content knowledge (~25%) or had helped them understand how to conduct hands-on activities (~25%), use manipulatives (25%), or anticipate problems students might encounter with certain concepts or procedures (38%). Similarly, at least a fifth of teaches also reflected that they did not feel prepared to teach STEM to students with special learning needs (~25%) or to English language learners (25%).

These findings provide C-STEM with an opportunity to review and strengthen the preparation and support it provides to its teachers, with a focus on the areas identified in this report.

Future research. There were several interesting findings that emerged from the evaluation that merit further research. First, the findings suggest that the African American and Latino students were quite positive about their own STEM abilities, which stands in contrast to the conventional wisdom. Future research should investigate this further to understand why this is.

Second, C-STEM does well with its young women, future research should investigate what it is about the program, the teacher training, and program implementation that might contribute to this finding.

Finally, additional research is needed to investigate the finding that students who reported being interested in STEM careers were not also interested in STEM courses. It may be that students do not understand the relationship between basic science and mathematics learning with future careers, and C-STEM would be well-poised to help make those connections.

Future evaluations. Given the nature of this particular study and the limitations inherent in its design, there are several recommendations for future evaluations that should improve the quality and usefulness of the findings:

1. Coordinate with a school district or charter management organization by applying for formal permission to conduct a study; this will allow for access to more student data, for the administration and linking of a pre- and post-survey, and for the creation of a control group;
2. Utilize a unique identifier to link students from the pre- to the post-survey and to their standardized test scores. A pre-/post-survey design would allow C-STEM to see the extent to which students have improved their attitudes as a result of participating in C-STEM;
3. Consider providing an incentive for responding to the survey to increase response rates to at least 50% of students and teachers;
4. Consider using a teacher log in which teachers can record information about how and how often they are implementing C-STEM and its different; this will provide information on program implementation that would be useful for understanding differences in impact across teachers and schools. More detailed implementation data also would help C-STEM understand how to better serve its teachers through its professional development opportunities;
5. Consider the following changes to the student survey:
    a. Use the whole survey to measure math, science, and engineering;
    b. Get rid of neutral response options as they are not particularly meaningful in context;
    c. Clarify the question about prior STEM program participation so that the non-C-STEM options clearly reflect that;
    d. Include a question about how many years students have participated in C-STEM;
6. Consider the following changes to the teacher survey:
    a. In the teacher survey, ask teachers about how they typically implement C-STEM (i.e., as an afterschool program or during the regular school day);
    b. Utilize clearly labeled response options and do not include a neutral middle response;
7. Restrict participation in the survey to the appropriate age groups in elementary school: Fourth through fifth grades. Given the survey was not created for younger students, it may not be valid or reliable. Consider using an available measure of science knowledge for Pre-K.

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Appendix A

Original surveys.

Appendix

Upper Elementary School Student Attitudes toward STEM (S-STEM) – 4-5th

Directions:

There are lists of statements on the following pages. Please mark your answer sheets by marking how you feel about each statement. For example:

Example 1:	Strongly Disagree	Disagree	Neither Agree nor Disagree	Agree	Strongly Agree
I like engineering.	○	○	○	○	○

As you read the sentence, you will know whether you agree or disagree. Fill in the circle that describes how much you agree or disagree.

Even though some statements are very similar, please answer each statement. This is not timed; work fast, but carefully.

There are no "right" or "wrong" answers! The only correct responses are those that are true for you. Whenever possible, let the things that have happened to you help you make a choice.

Please fill in on only one answer per question.

Recommended citation for this survey:

> Friday Institute for Educational Innovation (2012). *Upper Elementary School Student Attitudes toward STEM Survey*. Raleigh, NC: Author.

Math

	Strongly Disagree	Disagree	Neither Agree nor Disagree	Agree	Strongly Agree
1. Math has been my worst subject.	○	○	○	○	○
2. I would consider choosing a career that uses math.	○	○	○	○	○
3. Math is hard for me.	○	○	○	○	○
4. I am the type of student to do well in math.	○	○	○	○	○
5. I can handle most subjects well, but I cannot do a good job with math.	○	○	○	○	○
6. I am sure I could do advanced work in math.	○	○	○	○	○
7. I can get good grades in math.	○	○	○	○	○
8. I am good at math.	○	○	○	○	○

Science

	Strongly Disagree	Disagree	Neither Agree nor Disagree	Agree	Strongly Agree
9. I am sure of myself when I do science.	○	○	○	○	○
10. I would consider a career in science.	○	○	○	○	○
11. I expect to use science when I get out of school.	○	○	○	○	○
12. Knowing science will help me earn a living.	○	○	○	○	○
13. I will need science for my future work.	○	○	○	○	○
14. I know I can do well in science.	○	○	○	○	○
15. Science will be important to me in my life’s work.	○	○	○	○	○
16. I can handle most subjects well, but I cannot do a good job with science.	○	○	○	○	○

	Strongly Disagree	Disagree	Neither Agree nor Disagree	Agree	Strongly Agree
17. I am sure I could do advanced work in science.	○	○	○	○	○

Engineering and Technology

Please read this paragraph before you answer the questions.

Engineers use math, science, and creativity to research and solve problems that improve everyone's life and to invent new products. There are many different types of engineering, such as chemical, electrical, computer, mechanical, civil, environmental, and biomedical. Engineers design and improve things like bridges, cars, fabrics, foods, and virtual reality amusement parks. **Technologists** implement the designs that engineers develop; they build, test, and maintain products and processes.

	Strongly Disagree	Disagree	Neither Agree nor Disagree	Agree	Strongly Agree
18. I like to imagine creating new products.	○	○	○	○	○
19. If I learn engineering, then I can improve things that people use every day.	○	○	○	○	○
20. I am good at building and fixing things.	○	○	○	○	○
21. I am interested in what makes machines work.	○	○	○	○	○
22. Designing products or structures will be important for my future work.	○	○	○	○	○
23. I am curious about how electronics work.	○	○	○	○	○
24. I would like to use creativity and innovation in my future work.	○	○	○	○	○
25. Knowing how to use math and science together will allow me to invent useful things.	○	○	○	○	○
26. I believe I can be successful in a career in engineering.	○	○	○	○	○

21st Century Skills

	Strongly Disagree	Disagree	Neither Agree nor Disagree	Agree	Strongly Agree
27. I am confident I can lead others to accomplish a goal.	○	○	○	○	○
28. I am confident I can encourage others to do their best.	○	○	○	○	○
29. I am confident I can produce high quality work.	○	○	○	○	○
30. I am confident I can respect the differences of my peers.	○	○	○	○	○
31. I am confident I can help my peers.	○	○	○	○	○
32. I am confident I can include others' perspectives when making decisions.	○	○	○	○	○
33. I am confident I can make changes when things do not go as planned.	○	○	○	○	○
34. I am confident I can set my own learning goals.	○	○	○	○	○
35. I am confident I can manage my time wisely when working on my own.	○	○	○	○	○
36. When I have many assignments, I can choose which ones need to be done first.	○	○	○	○	○
37. I am confident I can work well with students from different backgrounds.	○	○	○	○	○

Your Future

Here are descriptions of subject areas that involve math, science, engineering and/or technology, and lists of jobs connected to each subject area. As you read the list below, you will know how interested you are in the subject and the jobs. Fill in the circle that relates to how interested you are.

There are no “*right*” or “*wrong*” answers. The only correct responses are those that *are true for you*.

	Not at all Interested	Not So Interested	Interested	Very Interested
1. **Physics:** is the study of basic laws governing the motion, energy, structure, and interactions of matter. This can include studying the nature of the universe. *(aviation engineer, alternative energy technician, lab technician, physicist, astronomer)*	○	○	○	○
2. **Environmental Work:** involves learning about physical and biological processes that govern nature and working to improve the environment. This includes finding and designing solutions to problems like pollution, reusing waste and recycling. *(pollution control analyst, environmental engineer or scientist, erosion control specialist, energy systems engineer and maintenance technician)*	○	○	○	○
3. **Biology and Zoology:** involve the study of living organisms (such as plants and animals) and the processes of life. This includes working with farm animals and in areas like nutrition and breeding. (*biological technician, biological scientist, plant breeder, crop lab technician, animal scientist, geneticist, zoologist)*	○	○	○	○
4. **Veterinary Work:** involves the science of preventing or treating disease in animals. *(veterinary assistant, veterinarian, livestock producer, animal caretaker)*	○	○	○	○
5. **Mathematics:** is the science of numbers and their operations. It involves computation, algorithms and theory used to solve problems and summarize data. *(accountant, applied mathematician, economist, financial analyst, mathematician, statistician, market researcher, stock market analyst)*	○	○	○	○

	Not at all Interested	Not So Interested	Interested	Very Interested
6. **Medicine:** involves maintaining health and preventing and treating disease. *(physician's assistant, nurse, doctor, nutritionist, emergency medical technician, physical therapist, dentist)*	○	○	○	○
7. **Earth Science:** is the study of earth, including the air, land, and ocean. *(geologist, weather forecaster, archaeologist, geoscientist)*	○	○	○	○
8. **Computer Science:** consists of the development and testing of computer systems, designing new programs and helping others to use computers. *(computer support specialist, computer programmer, computer and network technician, gaming designer, computer software engineer, information technology specialist)*	○	○	○	○
9. **Medical Science:** involves researching human disease and working to find new solutions to human health problems. *(clinical laboratory technologist, medical scientist, biomedical engineer, epidemiologist, pharmacologist)*	○	○	○	○
10. **Chemistry:** uses math and experiments to search for new chemicals, and to study the structure of matter and how it behaves. *(chemical technician, chemist, chemical engineer)*	○	○	○	○
11. **Energy:** involves the study and generation of power, such as heat or electricity. *(electrician, electrical engineer, heating, ventilation, and air conditioning (HVAC) technician, nuclear engineer, systems engineer, alternative energy systems installer or technician)*	○	○	○	○

	Not at all Interested	Not So Interested	Interested	Very Interested
12. **Engineering:** involves designing, testing, and manufacturing new products (like machines, bridges, buildings, and electronics) through the use of math, science, and computers. *(civil, industrial, agricultural, or mechanical engineers, welder, auto-mechanic, engineering technician, construction manager)*	○	○	○	○

About Yourself

1. How well do you expect to do this year in your:

	Not Very Well	OK/Pretty Well	Very Well
English/Language Arts Class?	○	○	○
Math Class?	○	○	○
Science Class?	○	○	○

2. More about you.

	Yes	No	Not Sure
Do you know any adults who work as scientists?	○	○	○
Do you know any adults who work as engineers?	○	○	○
Do you know any adults who work as mathematicians?	○	○	○
Do you know any adults who work as technologists?	○	○	○

Middle/High School Student Attitudes toward STEM (S-STEM) – 6-12th

Directions:

There are lists of statements on the following pages. Please mark your answer sheets by marking how you feel about each statement. For example:

Example 1:	Strongly Disagree	Disagree	Neither Agree nor Disagree	Agree	Strongly Agree
I like engineering.	○	○	○	○	○

As you read the sentence, you will know whether you agree or disagree. Fill in the circle that describes how much you agree or disagree.

Even though some statements are very similar, please answer each statement. This is not timed; work fast, but carefully.

There are no "right" or "wrong" answers! The only correct responses are those that are true *for you*. Whenever possible, let the things that have happened to you help you make a choice.

Please fill in only one answer per question.

Recommended citation for this survey:

> Friday Institute for Educational Innovation (2012). *Middle/High School Student Attitudes toward STEM Survey*. Raleigh, NC: Author.

Math

	Strongly Disagree	Disagree	Neither Agree nor Disagree	Agree	Strongly Agree
27. Math has been my worst subject.	○	○	○	○	○
28. I would consider choosing a career that uses math.	○	○	○	○	○
29. Math is hard for me.	○	○	○	○	○
30. I am the type of student to do well in math.	○	○	○	○	○
31. I can handle most subjects well, but I cannot do a good job with math.	○	○	○	○	○
32. I am sure I could do advanced work in math.	○	○	○	○	○
33. I can get good grades in math.	○	○	○	○	○
34. I am good at math.	○	○	○	○	○

Science

	Strongly Disagree	Disagree	Neither Agree nor Disagree	Agree	Strongly Agree
35. I am sure of myself when I do science.	○	○	○	○	○
36. I would consider a career in science.	○	○	○	○	○
37. I expect to use science when I get out of school.	○	○	○	○	○
38. Knowing science will help me earn a living.	○	○	○	○	○
39. I will need science for my future work.	○	○	○	○	○
40. I know I can do well in science.	○	○	○	○	○
41. Science will be important to me in my life’s work.	○	○	○	○	○
42. I can handle most subjects well, but I cannot do a good job with science.	○	○	○	○	○

	Strongly Disagree	Disagree	Neither Agree nor Disagree	Agree	Strongly Agree
43. I am sure I could do advanced work in science.	○	○	○	○	○

Engineering and Technology

Please read this paragraph before you answer the questions.

Engineers use math, science, and creativity to research and solve problems that improve everyone's life and to invent new products. There are many different types of engineering, such as chemical, electrical, computer, mechanical, civil, environmental, and biomedical. Engineers design and improve things like bridges, cars, fabrics, foods, and virtual reality amusement parks. **Technologists** implement the designs that engineers develop; they build, test, and maintain products and processes.

	Strongly Disagree	Disagree	Neither Agree nor Disagree	Agree	Strongly Agree
44. I like to imagine creating new products.	○	○	○	○	○
45. If I learn engineering, then I can improve things that people use every day.	○	○	○	○	○
46. I am good at building and fixing things.	○	○	○	○	○
47. I am interested in what makes machines work.	○	○	○	○	○
48. Designing products or structures will be important for my future work.	○	○	○	○	○
49. I am curious about how electronics work.	○	○	○	○	○
50. I would like to use creativity and innovation in my future work.	○	○	○	○	○
51. Knowing how to use math and science together will allow me to invent useful things.	○	○	○	○	○
52. I believe I can be successful in a career in engineering.	○	○	○	○	○

21st Century Skills

	Strongly Disagree	Disagree	Neither Agree nor Disagree	Agree	Strongly Agree
38. I am confident I can lead others to accomplish a goal.	○	○	○	○	○
39. I am confident I can encourage others to do their best.	○	○	○	○	○
40. I am confident I can produce high quality work.	○	○	○	○	○
41. I am confident I can respect the differences of my peers.	○	○	○	○	○
42. I am confident I can help my peers.	○	○	○	○	○
43. I am confident I can include others' perspectives when making decisions.	○	○	○	○	○
44. I am confident I can make changes when things do not go as planned.	○	○	○	○	○
45. I am confident I can set my own learning goals.	○	○	○	○	○
46. I am confident I can manage my time wisely when working on my own.	○	○	○	○	○
47. When I have many assignments, I can choose which ones need to be done first.	○	○	○	○	○
48. I am confident I can work well with students from different backgrounds.	○	○	○	○	○

Your Future

Here are descriptions of subject areas that involve math, science, engineering and/or technology, and lists of jobs connected to each subject area. As you read the list below, you will know how interested you are in the subject and the jobs. Fill in the circle that relates to how interested you are.

There are no "*right*" or "*wrong*" answers. The only correct responses are those that *are true for you*.

	Not at all Interested	Not So Interested	Interested	Very Interested
13. **Physics:** is the study of basic laws governing the motion, energy, structure, and interactions of matter. This can include studying the nature of the universe. *(aviation engineer, alternative energy technician, lab technician, physicist, astronomer)*	○	○	○	○
14. **Environmental Work:** involves learning about physical and biological processes that govern nature and working to improve the environment. This includes finding and designing solutions to problems like pollution, reusing waste and recycling. *(pollution control analyst, environmental engineer or scientist, erosion control specialist, energy systems engineer and maintenance technician)*	○	○	○	○
15. **Biology and Zoology:** involve the study of living organisms (such as plants and animals) and the processes of life. This includes working with farm animals and in areas like nutrition and breeding. (*biological technician, biological scientist, plant breeder, crop lab technician, animal scientist, geneticist, zoologist)*	○	○	○	○
16. **Veterinary Work:** involves the science of preventing or treating disease in animals. *(veterinary assistant, veterinarian, livestock producer, animal caretaker)*	○	○	○	○
17. **Mathematics:** is the science of numbers and their operations. It involves computation, algorithms and theory used to solve problems and summarize data. *(accountant, applied mathematician, economist, financial analyst, mathematician, statistician, market researcher, stock market analyst)*	○	○	○	○

	Not at all Interested	Not So Interested	Interested	Very Interested
18. **Medicine:** involves maintaining health and preventing and treating disease. *(physician's assistant, nurse, doctor, nutritionist, emergency medical technician, physical therapist, dentist)*	○	○	○	○
19. **Earth Science:** is the study of earth, including the air, land, and ocean. *(geologist, weather forecaster, archaeologist, geoscientist)*	○	○	○	○
20. **Computer Science:** consists of the development and testing of computer systems, designing new programs and helping others to use computers. *(computer support specialist, computer programmer, computer and network technician, gaming designer, computer software engineer, information technology specialist)*	○	○	○	○
21. **Medical Science:** involves researching human disease and working to find new solutions to human health problems. *(clinical laboratory technologist, medical scientist, biomedical engineer, epidemiologist, pharmacologist)*	○	○	○	○
22. **Chemistry:** uses math and experiments to search for new chemicals, and to study the structure of matter and how it behaves. *(chemical technician, chemist, chemical engineer)*	○	○	○	○
23. **Energy:** involves the study and generation of power, such as heat or electricity. *(electrician, electrical engineer, heating, ventilation, and air conditioning (HVAC) technician, nuclear engineer, systems engineer, alternative energy systems installer or technician)*	○	○	○	○

	Not at all Interested	Not So Interested	Interested	Very Interested
24. **Engineering:** involves designing, testing, and manufacturing new products (like machines, bridges, buildings, and electronics) through the use of math, science, and computers. *(civil, industrial, agricultural, or mechanical engineers, welder, auto-mechanic, engineering technician, construction manager)*	○	○	○	○

About Yourself

1. How well do you expect to do this year in your:

	Not Very Well	OK/Pretty Well	Very Well
English/Language Arts Class?	○	○	○
Math Class?	○	○	○
Science Class?	○	○	○

2. In the future, do you plan to take advanced classes in:

	Yes	No	Not Sure
Mathematics?	○	○	○
Science?	○	○	○

3. Do you plan to go to college?

- ❍ Yes
- ❍ No
- ❍ Not Sure

4. More about you.

	Yes	No	Not Sure
Do you know any adults who work as scientists?	○	○	○
Do you know any adults who work as engineers?	○	○	○
Do you know any adults who work as mathematicians?	○	○	○
Do you know any adults who work as technologists?	○	○	○

Appendix B

Version of surveys used in evaluation study.

Elementary School Students Attitudes Toward STEM

QUESTIONS RESPONSES 65

Student Attitudes towards STEM

The development of high school student survey.

Elementary School Student Attitudes toward STEM

Description (optional)

School Name *

Short answer text

Grade Level *

- 2nd Grade
- 3rd Grade
- 4th Grade
- 5th Grade

Gender *

- Female

Prior to C-STEM, I participated in other STEM *

- Only C-STEM Programs
- 1-5 STEM Programs
- 6-10 STEM Programs
- More than 10 STEM Programs
- Strongly Agree

I will participate in future STEM Programs *

- Yes
- No

I am interested in a STEM related career *

- Yes
- No

My parent(s) are involved with supporting my participation in *

- Yes
- No

I can handle most subjects well, but I cannot do a good job with *

- Strongly Disagree

- Disagree
- Neither Agree nor Disagree
- Agree
- Strongly Agree

I am sure I could do advanced work in math. *

- Strongly Disagree
- Disagree
- Neither Agree nor Disagree
- Agree
- Strongly Agree

I can handle most subjects well, but I cannot do a good job with *

- Strongly Disagree
- Disagree
- Neither Agree nor Disagree
- Agree
- Strongly Agree

Please read this paragraph before you answer the

ENGINEERS use math, science, and creativity to research and solve problems that improve everyone's life and to invent new iproducts. There are many different types of engineering, such as chemical, electrical, computer, mechanical, civil, environmental, and bio-medical. Engineers design and improve things like bridges, cars, fabrics, foods, and virtual reality amusement parks. Technologists implement the designs that engineers develop; they build, test, and maintain products and processes.

I like to imagine creating new products. *

- Strongly Disagree
- Disagree
- Neither Agree nor Disagree
- Agree
- Strongly Agree

If I learn engineering, then I can improve things that people use every *

- Strongly Disagree
- Disagree
- Neither Agree nor Disagree
- Agree
- Strongly Agree

I am good at building and fixing things. *

- Strongly Disagree
- Disagree
- Neither Agree nor Disagree
- Agree

- Strongly Agree

I am interested in what makes machines work. *

- Strongly Disagree
- Disagree
- Neither Agree nor Disagree
- Agree
- Strongly Agree

Designing products or structures will be important for my future *

- Strongly Disagree
- Disagree
- Neither Agree nor Disagree
- Agree
- Strongly Agree

I am curious about how electronics work. *

- Strongly Disagree
- Disagree
- Neither Agree nor Disagree
- Agree

Strongly Agree

I would like to use creativity and innovation in my future *

Strongly Disagree

Disagree

Neither Agree nor Disagree

Agree

Strongly Agree

Knowing how to use math and science together will allow me to invent useful things. *

Strongly Disagree

Disagree

Neither Agree nor Disagree

Agree

Strongly Agree

I believe I can be successful in an engineering *

Strongly Disagree

Disagree

Neither Agree nor Disagree

Agree

Strongly Agree

I am confident I can lead others to accomplish a *

Strongly Disagree

Disagree

Neither Agree nor Disagree

Agree

Strongly Agree

I am confident I can encourage others to do their *

Strongly Disagree

Disagree

Neither Agree nor Disagree

Agree

Strongly Agree

I am confident I can produce high quality work. *

Strongly Disagree

Disagree

Neither Agree nor Disagree

Agree

- Strongly Agree

I am confident I can respect the differences of my *

- Strongly Disagree
- Disagree
- Neither Agree nor Disagree
- Agree
- Strongly Agree

I am confident I can help my peers. *

- Strongly Disagree
- Disagree
- Neither Agree nor Disagree
- Agree
- Strongly Agree

I am confident I can include others' perspectives when making *

- Strongly Disagree
- Disagree
- Neither Agree nor Disagree
- Agree

Strongly Agree

I am confident I can make changes when things do not go as *

Strongly Disagree

Disagree

Neither Agree nor Disagree

Agree

Strongly Agree

I am confident I can set my own learning goals. *

Strongly Disagree

Disagree

Neither Agree nor Disagree

Agree

Strongly Agree

I am confident I can manage my time wisely when working on my *

Strongly Disagree

Disagree

Neither Agree nor Disagree

Agree

- Strongly Agree

When I have many assignments, I can choose which ones need to be done first. *

- Strongly Disagree
- Disagree
- Neither Agree nor Disagree
- Agree
- Strongly Agree

I am confident I can work well with students from different *

- Strongly Disagree
- Disagree
- Neither Agree nor Disagree
- Agree
- Strongly Agree

Your Future

Here are descriptions of subject areas that involve math, science, engineering and/or technology, and lists of jobs connected to each subject area. As you read the list below, you will know how interested you are in the subject and the jobs. Select the circle that relates to how interested you are.

There are no "right" or "wrong" answers. The only correct responses are those that are true for you.

*

Physics: is the study of basic laws governing the motion, energy, structure, and interactions of matter. This can include studying the nature of the universe. (aviation engineer, alternative energy technician, lab technician, physicist, astronomer)

- Not at all Interested
- Not So Interested
- Interested
- Very Interested

Environmental Work: involves learning about physical and biological processes that govern nature and working to improve the environment. This includes finding and designing solutions to problems like pollution, reusing waste and recycling. (pollution control analyst, environmental engineer or scientist, erosion control specialist, energy systems engineer and maintenance technician) *

- Not at all Interested
- Not So Interested
- Interested
- Very Interested

Biology and Zoology: involve the study of living organisms (such as plants and animals) and the processes of life. This includes working with farm animals and in areas like nutrition and breeding. (biological technician, biological scientist, plant breeder, crop lab technician, animal scientist, geneticist, zoologist) *

- Not at all Interested

- Not So Interested
- Interested
- Very Interested

Veterinary Work: involves the science of preventing or treating disease in animals. (veterinary assistant, veterinarian, livestock producer, animal caretaker) *

- Not at all Interested
- Not So Interested
- Interested
- Very Interested

Mathematics: is the science of numbers and their operations. It involves computation, algorithms and theory used to solve problems and summarized data. (accountant, applied mathematician, economist, financial analyst, mathematician, statistician, market researcher, stock market analyst) *

- Not at all Interested
- Not So Interested
- Interested
- Very Interested

Medicine: involves maintaining health and preventing and treating disease. (physician's assistant, nurse, doctor, nutritionist, emergency medical technician, physical therapist, dentist) *

- Not at all Interested
- Not So Interested
- Interested
- Very Interested

Earth Science: is the study of earth, including the air, land, and ocean. (geologist, weather forecaster, archaeologist, Geo-scientist). *

- Not at all Interested
- Not So Interested
- Interested
- Very Interested

Computer Science: consists of the development and testing of computer systems, designing new program and helping others to use computers. (computer support specialist, computer programmer, computer and network technician, gaming designer, computer software engineer, information technology specialist) *

- Not at all Interested
- Not So Interested
- Interested
- Very Interested

*

Medical Science: involves researching human disease and working to find new solutions to human health problems. (clinical laboratory technologist, medical scientist, bio-medical engineer, epidemiologist,

- Not at all Interested
- Not So Interested
- Interested
- Very Interested

Chemistry: uses math and experiments to search for new chemicals, and to study the structure of matter and how it behaves. (chemical technician, chemist, chemical engineer) *

- Not at all Interested
- Not So Interested
- Interested
- Very Interested

Energy: Involves the study and generation of power, such as heat or electricity. (electrician, electrical engineer, heating, ventilation, and air conditioning (HVAC) technician, nuclear engineer, systems engineer, alternative energy systems installer or technician. *

- Not at all Interested
- Not So Interested
- Interested
- Very Interested

Engineering: involves designing, testing, and manufacturing new products (like machines, bridges, buildings, and electronics) through the use of math, science, and computers. (civil, industrial, agricultural, or mechanical engineers, welder, auto-mechanic, engineering technician, construction manager) *

- Not at all Interested
- Not So Interested
- Interested
- Very Interested

How well do you expect to do this year in your English/Language Arts *

- Not Very Well
- OK/Pretty Well
- Very Well

How well do you expect to do this year in your Math *

- Not Very Well
- OK/Pretty Well
- Very Well

How well do you expect to do this year in your Science *

- Not Very Well

- OK/Pretty Well
- Very Well

In the future, do you plan to take advanced classes in *

- Yes
- No
- Not Sure

In the future, do you plan to take advanced classes in *

- Yes
- No
- Not Sure

Do you plan to go to college? *

- Yes
- No
- Not Sure

Do you know any adults who work as scientists? *

- Yes
- No
- Not Sure

Do you know any adults who work as engineers? *

- Yes
- No
- Not Sure

Do you know any adults who work as *

- Yes
- No
- Not Sure

Do you know any adults who work as technologists? *

- Yes
- No
- Not Sure

Middle & High School Students Attitudes Toward STEM

QUESTIONS RESPONSES 116

Student Attitudes towards STEM

The development of high school student survey.

Middle & High School Student Attitudes toward STEM

Description (optional)

School Name *

Short answer text

Grade Level *

- 6th Grade
- 7th Grade
- 8th Grade
- 9th Grade
- 10th Grade
- 11th Grade
- 12th Grade

Gender *

- Female
- Male

Prior to C-STEM, I participated in other STEM *

- Only C-STEM Programs
- 1-5 STEM Programs
- 6-10 STEM Programs
- More than 10 STEM Programs
- Strongly Agree

I will participate in future STEM Programs *

- Yes
- No

I am interested in a STEM related career *

- Yes
- No

My parent(s) are involved with supporting my participation in *

- Yes

No

I can handle most subjects well, but I cannot do a good job with *

Strongly Disagree

Disagree

Neither Agree nor Disagree

Agree

Strongly Agree

I am sure I could do advanced work in math. *

Strongly Disagree

Disagree

Neither Agree nor Disagree

Agree

Strongly Agree

I can handle most subjects well, but I cannot do a good job with *

Strongly Disagree

Disagree

Neither Agree nor Disagree

Agree

Strongly Agree

Please read this paragraph before you answer the

ENGINEERS use math, science, and creativity to research and solve problems that improve everyone's life and to invent new iproducts. There are many different types of engineering, such as chemical, electrical, computer, mechanical, civil, environmental, and bio-medical. Engineers design and improve things like bridges, cars, fabrics, foods, and virtual reality amusement parks. Technologists implement the designs that engineers develop; they build, test, and maintain products and processes.

I like to imagine creating new products. *

- Strongly Disagree
- Disagree
- Neither Agree nor Disagree
- Agree
- Strongly Agree

If I learn engineering, then I can improve things that people use every *

- Strongly Disagree
- Disagree
- Neither Agree nor Disagree
- Agree
- Strongly Agree

I am good at building and fixing things. *

- Strongly Disagree

- Disagree
- Neither Agree nor Disagree
- Agree
- Strongly Agree

I am interested in what makes machines work. *

- Strongly Disagree
- Disagree
- Neither Agree nor Disagree
- Agree
- Strongly Agree

Designing products or structures will be important for my future *

- Strongly Disagree
- Disagree
- Neither Agree nor Disagree
- Agree
- Strongly Agree

I am curious about how electronics work. *

- Strongly Disagree
- Disagree

- Neither Agree nor Disagree
- Agree
- Strongly Agree

I would like to use creativity and innovation in my future *

- Strongly Disagree
- Disagree
- Neither Agree nor Disagree
- Agree
- Strongly Agree

Knowing how to use math and science together will allow me to invent useful things. *

- Strongly Disagree
- Disagree
- Neither Agree nor Disagree
- Agree
- Strongly Agree

I believe I can be successful in an engineering *

- Strongly Disagree

Disagree

Neither Agree nor Disagree

Agree

Strongly Agree

I am confident I can lead others to accomplish a *

Strongly Disagree

Disagree

Neither Agree nor Disagree

Agree

Strongly Agree

I am confident I can encourage others to do their *

Strongly Disagree

Disagree

Neither Agree nor Disagree

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Strongly Agree

I am confident I can produce high quality work. *

Strongly Disagree

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Neither Agree nor Disagree

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Strongly Agree

I am confident I can respect the differences of my *

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Strongly Agree

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Strongly Disagree

Disagree

Neither Agree nor Disagree

Agree

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I am confident I can include others' perspectives when making *

Strongly Disagree

Disagree

- Neither Agree nor Disagree
- Agree
- Strongly Agree

I am confident I can make changes when things do not go as *

- Strongly Disagree
- Disagree
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- Agree
- Strongly Agree

I am confident I can set my own learning goals. *

- Strongly Disagree
- Disagree
- Neither Agree nor Disagree
- Agree
- Strongly Agree

I am confident I can manage my time wisely when working on my *

- Strongly Disagree
- Disagree

- Neither Agree nor Disagree
- Agree
- Strongly Agree

When I have many assignments, I can choose which ones need to be done first. *

- Strongly Disagree
- Disagree
- Neither Agree nor Disagree
- Agree
- Strongly Agree

I am confident I can work well with students from different *

- Strongly Disagree
- Disagree
- Neither Agree nor Disagree
- Agree
- Strongly Agree

Your Future

Here are descriptions of subject areas that involve math, science, engineering and/or technology, and lists of jobs connected to each subject area. As you read the list below, you will know how interested you are in the subject and the jobs. Select the circle that relates to how interested you are.

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Physics: is the study of basic laws governing the motion, energy, structure, and interactions of matter. This can include studying the nature of the universe. (aviation engineer, alternative energy technician, lab technician, physicist, astronomer) *

- Not at all Interested
- Not So Interested
- Interested
- Very Interested

Environmental Work: involves learning about physical and biological processes that govern nature and working to improve the environment. This includes finding and designing solutions to problems like pollution, reusing waste and recycling. (pollution control analyst, environmental engineer or scientist, erosion control specialist, energy systems engineer and maintenance technician) *

- Not at all Interested
- Not So Interested
- Interested
- Very Interested

*

Biology and Zoology: involve the study of living organisms (such as plants and animals) and the processes of life. This includes working with farm animals and in areas like nutrition and breeding. (biological technician, biological scientist, plant breeder, crop lab technician, animal scientist, geneticist, zoologist)

- Not at all Interested
- Not So Interested
- Interested
- Very Interested

Veterinary Work: involves the science of preventing or treating disease in animals. (veterinary assistant, veterinarian, livestock producer, animal caretaker) *

- Not at all Interested
- Not So Interested
- Interested
- Very Interested

Mathematics: is the science of numbers and their operations. It involves computation, algorithms and theory used to solve problems and summarized data. (accountant, applied mathematician, economist, financial analyst, mathematician, statistician, market researcher, stock market analyst) *

- Not at all Interested
- Not So Interested

Interested

Very Interested

Medicine: involves maintaining health and preventing and treating disease. (physician's assistant, nurse, doctor, nutritionist, emergency medical technician, physical therapist, dentist) *

Not at all Interested

Not So Interested

Interested

Very Interested

Earth Science: is the study of earth, including the air, land, and ocean. (geologist, weather forecaster, archaeologist, Geo-scientist). *

Not at all Interested

Not So Interested

Interested

Very Interested

Computer Science: consists of the development and testing of computer systems, designing new program and helping others to use computers. (computer support specialist, computer programmer, computer and network technician, gaming designer, computer software engineer, information technology specialist) *

Not at all Interested

Not So Interested

Interested

Very Interested

Medical Science: involves researching human disease and working to find new solutions to human health problems. (clinical laboratory technologist, medical scientist, bio-medical engineer, epidemiologist, *

Not at all Interested

Not So Interested

Interested

Very Interested

Chemistry: uses math and experiments to search for new chemicals, and to study the structure of matter and how it behaves. (chemical technician, chemist, chemical engineer) *

Not at all Interested

Not So Interested

Interested

Very Interested

Energy: Involves the study and generation of power, such as heat or electricity. (electrician, electrical engineer, heating, ventilation, and air conditioning (HVAC) technician, nuclear engineer, systems engineer, alternative energy systems installer or technician. *

Not at all Interested

- Not So Interested
- Interested
- Very Interested

Engineering: involves designing, testing, and manufacturing new products (like machines, bridges, buildings, and electronics) through the use of math, science, and computers. (civil, industrial, agricultural, or mechanical engineers, welder, auto-mechanic, engineering technician, construction manager) *

- Not at all Interested
- Not So Interested
- Interested
- Very Interested

How well do you expect to do this year in your English/Language Arts *

- Not Very Well
- OK/Pretty Well
- Very Well

How well do you expect to do this year in your Math *

- Not Very Well
- OK/Pretty Well
- Very Well

How well do you expect to do this year in your Science *

- Not Very Well
- OK/Pretty Well
- Very Well

In the future, do you plan to take advanced classes in *

- Yes
- No
- Not Sure

In the future, do you plan to take advanced classes in *

- Yes
- No
- Not Sure

Do you plan to go to college? *

- Yes
- No
- Not Sure

*

Do you know any adults who work as scientists?

- Yes
- No
- Not Sure

Do you know any adults who work as engineers? *

- Yes
- No
- Not Sure

Do you know any adults who work as *

- Yes
- No
- Not Sure

Do you know any adults who work as technologists? *

- Yes
- No
- Not Sure

TEACHER STEM EDUCATION SURVEY AND QUESTIONNAIRE

1. **1. At what grade levels do you currently Teach STEM? [Select all that apply]**
   Mark only one oval.
   - K–5
   - 6–8
   - 9–12

2. **2. Which best describes your STEM teaching?**
   Mark only one oval.
   - I teach STEM all or most days, every week of the year.
   - I teach STEM every week, but typically three or fewer days each week.
   - I teach STEM some weeks, but typically not every week.
   - I do not teach STEM.as a class/afterschool program but as after-school enrichment

3. **3. In a typical week, how many days do you teach C-STEM lessons ?**
   Mark only one oval.
   - 1 day
   - 2 days
   - 3 days
   - 4 days
   - 5 days

4. **4. In a typical week, how many minutes per week do you teach C-STEM lessons ?**
   Mark only one oval.
   - 1 day
   - 2 days
   - 3 days
   - 4 days
   - 5 days

5. **4. In a typical week, how many students per week do you teach C-STEM lessons ?**
Mark only one oval.

- 5-10
- 11-20
- 21-30
- 31-40
- More than 40

6. **5. Which of the following best describes your teacher certification program?**
Mark only one oval.

- An undergraduate program leading to a bachelor's degree and a teaching credential
- A post-baccalaureate credentialing program (no master's degree awarded)
- A master's program that also awarded a teaching credential
- You do not have any formal teacher preparation

7. **6. In the last year have you… [Select all that apply.]**
Check all that apply.

- attended a national, state, or regional STEM teacher association meeting?
- participated in a professional learning community/lesson study/teacher study group focused on STEM or STEM teaching?
- participated in C-STEM Integrated STEM Teacher Training webinars, chat sessions, listened to STEMcast podcasts, or completed asynchronous training on-line

8. **Questions 7-19, thinking about all of your C-STEM-related professional development in the last year, to what extent does each of the following describe your experiences?**
Mark only one oval.

	1	2	3	4	5	
Not Adequately Prepared						Very Well Prepared

9. *Mark only one oval.*

- Option 1

10. **7. Deepening your own STEM content knowledge**
Mark only one oval.

	1	2	3	4	5	
Not Adequately Prepared						Very Well Prepared

11. **8. Learning how to use hands-on activities/manipulatives for STEM instruction**
Mark only one oval.

	1	2	3	4	5	
Not Adequately Prepared						Very Well Prepared

12. **9. Learning about difficulties that students may have with particular STEM ideas and procedures**
Mark only one oval.

	1	2	3	4	5	
Not Adequately Prepared						Very Well Prepared

13. **10. Implementing the C-STEM program to be used in your class/afterschool program**
Mark only one oval.

	1	2	3	4	5	
Not Adequately Prepared						Very Well Prepared

14. **11. Assessing student understanding of STEM at the conclusion of instruction on a topic**
Mark only one oval.

	1	2	3	4	5	
Not Adequately Prepared						Very Well Prepared

15. **12. How well prepared do you feel to plan instruction so students at different levels of achievement can increase their understanding of the ideas targeted in each activity**
Mark only one oval.

	1	2	3	4	5	
Not Adequately Prepared						Very Well Prepared

16. **13. How well prepared do you feel to teach STEM to students who have learning disabilities**
Mark only one oval.

	1	2	3	4	5	
Not Adequately Prepared						Very Well Prepared

17. **14. How well prepared do you feel to teach STEM to students who have physical disabilities**
Mark only one oval.

	1	2	3	4	5	
Not Adequately Prepared						Very Well Prepared

18. **`15. How well prepared do you feel to teach STEM to English-language learners**
Mark only one oval.

	1	2	3	4	5	
Not Adequately Prepared	⬭	⬭	⬭	⬭	⬭	Very Well Prepared

19. **`16. How well prepared do you feel to Encourage students' interest in STEM**
Mark only one oval.

	1	2	3	4	5	
Not Adequately Prepared	⬭	⬭	⬭	⬭	⬭	Very Well Prepared

20. **`17. How well prepared do you feel to encourage participation of females in STEM**
Mark only one oval.

	1	2	3	4	5	
Not Adequately Prepared	⬭	⬭	⬭	⬭	⬭	Very Well Prepared

21. **`18. How well prepared do you feel to encourage participation of racial or ethnic minorities in STEM**
Mark only one oval.

	1	2	3	4	5	
Not Adequately Prepared	⬭	⬭	⬭	⬭	⬭	Very Well Prepared

22. **`19. How well prepared do you feel to encourage participation of students from low socioeconomic backgrounds in STEM**
Mark only one oval.

	1	2	3	4	5	
Not Adequately Prepared	⬭	⬭	⬭	⬭	⬭	Very Well Prepared

23. **20. Enter the number of students for each grade represented in your C-STEM class/afterschool program. [Enter each response as a whole number (for example: 1st Grade, 15; 2nd Grade, 3; and 3rd Grade, 6).]**

24. **21. For the students in this C-STEM class/afterschool program, indicate the number of males and females by race/ethnicity. [Enter each response as a whole number (for example: American Indian 15 males and 20 females; Asian 3 males and 5 females; Hispanic/Latino 10 males and 10 females, etc.).]**

25. **22. Which of the following best describes the prior STEM achievement levels of the students in this class/afterschool program relative to other students in this school?**
Mark only one oval.
   - Mostly low achievers
   - Mostly average achievers
   - Mostly high achievers
   - A mixture of levels

26. **23. Thinking back over the year about your STEM teaching, how much emphasis was placed on learning about real-life applications of STEM**
Mark only one oval.

	1	2	3	4	5	
None						Heavy Emphasis

27. **24. Thinking back over the year about your STEM teaching, how much emphasis was placed on increasing students' interest in STEM**
Mark only one oval.

	1	2	3	4	5	
None						Heavy Emphasis

28. **25. Thinking back over the year about your STEM teaching, how much emphasis was placed on preparing for further study in STEM**
Mark only one oval.

	1	2	3	4	5	
None						Heavy Emphasis

29. **26. Thinking back over the year about your STEM teaching, how much emphasis was placed on learning test taking skills/strategies**
Mark only one oval.

	1	2	3	4	5	
None						Heavy Emphasis

30. **27. How often do students use personal computers, including laptops in this C-STEM class/afterschool program?**

Mark only one oval.

	1	2	3	4	5	
Never	◯	◯	◯	◯	◯	All or almost all the time

31. **28. How often do students use internet in this C-STEM class/afterschool program?**

Mark only one oval.

	1	2	3	4	5	
Never	◯	◯	◯	◯	◯	All or almost all the time

32. **29. How often do students use Mobile phones in this C-STEM class/afterschool program?**

Mark only one oval.

	1	2	3	4	5	
Never	◯	◯	◯	◯	◯	All or almost all the time

33. **30. Over the course of the school year, approximately what percentage of the C-STEM instructional time will students in this class/afterschool program spend in this program?**

Mark only one oval.

◯ Less than 25%
◯ 25–49%
◯ 50–74%
◯ 75–90%
◯ More than 90%

34. **31. Approximately what percentage of the module(s) in the C-STEM program will students in this class/afterschool program engage with during the school year?**

Mark only one oval.

◯ Less than 25%
◯ 25–49%
◯ 50–74%
◯ 75–90%
◯ More than 90%

35. **32. STEM course benefit from the availability of particular resources. Considering the C-STEM tool-kits you are provided, how adequate are they for teaching this STEM class/afterschool program?**

Mark only one oval.

	1	2	3	4	5	
Not Adequate	◯	◯	◯	◯	◯	Adequate

36. **33. Indicate your sex:**

Mark only one oval.

- Male
- Female

37. **34. Are you of Hispanic or Latino origin?**

Mark only one oval.

- Yes
- No

38. **35. What is your race? [Select all that apply.]**

Mark only one oval.

- American Indian or Alaska Native
- Asian
- Black or African American
- Native Hawaiian or Other Pacific Islander
- White

39. **36. In what year were you born? [Enter your response as a whole number (for example: 1969). Do not use commas.]**

____

40. **37. School Name:**

____

THANK YOU FOR COMPLETING THIS SURVEY!