SCIENCE LEADERSHIP INITIATIVE
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CHICAGO-AREA K-8 TEACHER AND ADMINISTRATOR PERCEPTIONS OF STEM EDUCATION

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INTRODUCTION

The informal education sector, including museums and science centers, is a critical component in the overall ecosystem of STEM education. Museums have served as a resource for schools and educators, and many have played an important role in supporting teachers in the classroom through professional development. The Museum of Science and Industry, Chicago (MSI) teacher professional development program, called the Institute for Quality Science Teaching (IQST), offers a rotation of five courses in different science content areas, including life, physical, earth, environmental, and space science. MSI collaborates with the nation's third largest school district, the Chicago Public Schools (CPS), neighboring school districts, and private schools in the area. A research study conducted in partnership with the Education Policy Center at Michigan State University found that the teacher course focusing on energy (physical science) increased teachers' content knowledge and teaching strategies, while also improving students' learning (Rodriguez, 2014; Schmidt & Cogan, 2014). By delivering STEM content instruction, modeling research-based pedagogical practices, and providing the physical materials required to implement science lessons at school, the IQST program model empowers teachers to immediately transform their classroom instruction.

One of the key lessons learned from nine years of IQST programming at local schools (nearly one-third of schools in the Chicago area have three or more teachers who have participated in a least one course) is that supporting STEM education means supporting the entire school. Effective science education goes beyond the science teachers, and includes the whole school environment. As a result, MSI is in the development stages of a new Science Leadership Initiative to advance school leadership in science education. We turned to the research literature to better understand STEM education and what best practices need to be established to make it successful at the whole-school level. However, the research that currently exists in this field is limited (Chiu, Price, & Ovrahim, 2015; National Research Council [NRC], 2011). The majority of the research focuses on STEM education at the high school level, but new standards are suggesting that incorporating STEM at the earlier grades will help build the knowledge basis for students to be successful with STEM in high school. The Initiative will address the role of administrators, teacher leaders, and other important stakeholders in ensuring that every child attends a school that demonstrates exceptional science education. The initial goals of the Science Leadership Initiative are to:

1. Use a School Support Tool created by MSI to help K-8 schools gauge their current science teaching and learning and plan next steps.

2. Develop a rewards and recognition program for schools that are doing the work of science education reform through the use of MSI's School Support Tool and implementation process.

3. Design additional supports to aid in the success of improving schools, such as strategic professional development targeted at principals and teacher leaders and an online, interactive network.

Utilizing advisory committee feedback, an extensive literature review on best practices (Chiu, Price & Ovrahim, 2015) and surveys of administrators and teachers, the project team is developing a School Support Tool to serve as a primary resource for schools to access and utilize recent literature on STEM teaching and learning, as identified by MSI. The tool will serve as an information-rich, self-assessment tool for K-8 schools to identify how well they support science education. Also, the Museum convened three advisory committee groups (national, teacher leader, and administrator) to provide input on project development through work sessions and focus groups. Six local schools were recruited as early collaborators to provide feedback from potential School Support Tool users.

Supporting STEM education means supporting the entire school.

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In order to better understand the local school community, we recognized the need for a baseline measure of educator perceptions of what they have, need, and want in terms of support and programming on their way to providing a quality learning environment for science. The initial research questions formed by the Science Leadership Initiative team included:

1. What are teacher and administrator perceptions and perceived value of STEM education in the greater Chicago area?

2. What supports can MSI provide teachers and administrators to deliver quality science education?

A survey was developed to answer these questions. We asked questions about awareness of STEM education, what schools do to support STEM and science education, and what is needed to deliver a quality science education to their students. Several questions originated from existing survey research on STEM and science education and teacher perceptions (Interactive, 2012; Moore & Foy, 1997). These items were included to help compare our population with the population that the research literature describes.

This paper begins with a brief literature review and describes a teacher and administrator survey component of the Science Leadership Initiative project. Another paper provides a more comprehensive literature review. A subsequent paper will describe the development of the Science Leadership Initiative.

One of the main outcomes of the literature review was the need to better understand the needs and expectations of schools in the greater Chicago area surrounding STEM education.

LITERATURE REVIEW

Four key themes emerged in a review of the literature around supporting K-12 STEM education. First, STEM has a variety of different meanings to teachers, administrators, and students. A study of over 200 teachers and administrators in the state of Illinois found that less than 50 percent understood the concept of STEM or could describe it (Brown, Brown, Reardon, & Merrill, 2011). Another study found that there is a lack of awareness in fourth- through 12^{th}-grade students of STEM careers, little opportunity to engage with STEM industries, and declining attitudes in STEM subject areas (Mahoney, 2009; Wiebe et al., 2013). Second, schools with successful STEM education have common characteristics, including teaching STEM in a more connected manner and referencing real-world issues, high professional capacity of faculty and staff, integrated and innovative use of technology, real-world STEM partnerships, and an inclusive STEM mission (Lynch, Behrend, Peters-Burton, & Means, 2014; NRC, 2011; NRC, 2014). Effective STEM programs and schools place an emphasis on teacher preparation and education through the use of professional development and peer coaching (Cotabish, Robinson, Dailey & Hughes, 2013; Nadelson et al., 2013; NRC, 2011) and classroom techniques such as problem-based learning and inquiry-based strategies (Smith, Douglas, & Cox, 2009). Lastly, we found a number of different model STEM school types from the literature, rather than one consistent model (NRC, 2011). One of the main outcomes of the literature review was the need to better understand the needs and expectations of schools in the greater Chicago area surrounding STEM education, to both inform program development of the Science Leadership Initiative and link the program's operating environment with that reported by the greater research literature. The Science Leadership Initiative is directed by the current best practices supported by research, and it was necessary to see how well the community it serves compares with the research populations as described by the literature.

SAMPLING PROCEDURES

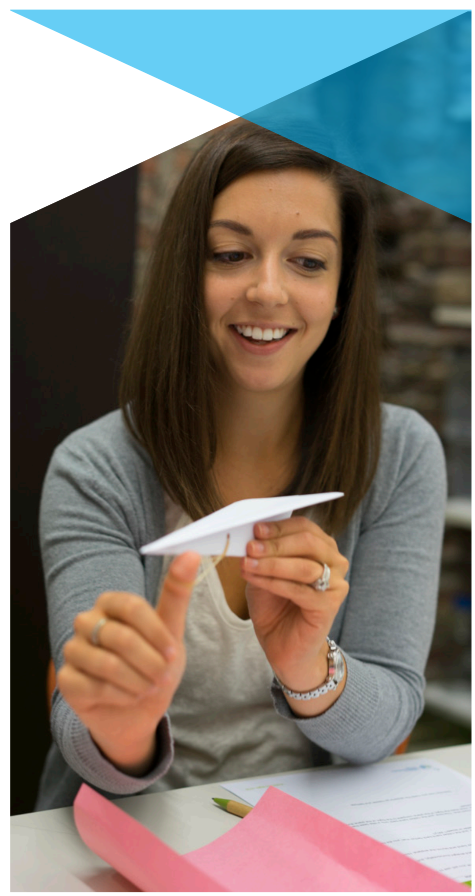
Our target audiences for the survey consisted of formal educators in the greater Chicago area, including administrators and teachers. We first defined our geographic area to include the city of Chicago and 23 suburbs with populations greater than 30,000 people.[1] The initial target population of the program includes kindergarten through eighth-grade teachers and schools. Therefore, our list of schools included public elementary and middle schools identified from city and town websites as well as charter, magnet, private, and parochial schools available through independent school databases. Schools that identified themselves as having total populations of fewer than 100 students were eliminated because these schools often do not need to abide by state education assessments or mandates and/or have unique educational philosophies.

Eight hundred thirty-nine K-8 schools were identified in Cook County, Ill., of which 172 schools were randomly selected. Three additional schools were included because they have a prior relationship with the Science Leadership Initiative program. Altogether, there were 175 surveyed schools total. Once these 175 schools were identified, one school administrator and one science teacher was selected based on available information through school websites and calls to school offices. Generally, the administrator was the school principal, unless the school office provided another name or email address for another administrator. Some school websites provided names and email addresses, and teachers and administrators with email addresses were more likely to be chosen.

[1] These include Arlington Heights, Bartlett, Buffalo Grove, Calumet City, Chicago Heights, Des Plaines, Elgin, Elk Grove Village, Evanston, Glenview, Hanover Park, Mount Prospect, Northbrook, Oak Lawn, Oak Park, Orland Park, Palatine, Park Ridge, Schaumburg, Skokie, Streamwood, Tinley Park, and Woodridge, Ill.

METHODS OF DATA COLLECTION

The survey consisted of 34 to 36 questions and had two platforms: electronic and paper. The electronic survey was created through the online survey software tool Survey Gizmo. There are four versions of the survey, with two versions each of the administrator and teacher survey. Each version has six (teacher) or seven (administrator) open-ended perception questions, 10 (teacher) to 11 (administrator) Likert or multiple choice questions, eight open-ended program development questions, and a series of demographic questions. The two versions of the surveys differ in the open-ended perception questions, rotating through a set of eight or nine questions to shorten survey length. Survey questions can be seen in Appendix A. The survey instrument was piloted with a group of teachers and administrators who have been past participants in MSI teacher courses. When pilot tested, the estimated completion time for the survey was 10 to 15 minutes. Three advisory committees, composed of national and local leaders in education policy and research, school administrators, and science teachers, helped to validate the survey through a number of focus groups and work sessions. All identified teachers and administrators were mailed a packet to their schools with a paper version of the survey and a postage paid return envelope. For schools with no identifiable administrator or teacher, the mailer was addressed to the School Principal or the Science Department Lead Teacher in the hopes that it would reach the appropriate individual. A link to the electronic version of the survey was also included in each packet. All envelopes were hand-addressed. Survey respondents were offered a $15 Amazon e-gift card in exchange for completing the survey. Surveys were deployed and mailed one and two weeks, respectively, after the first sample was emailed and mailed their surveys. After one week, a reminder email was sent to all available email addresses. Postcards were sent to all remaining persons who had not responded to the survey two weeks after mailings. The survey was open for five weeks total, in the early fall of 2014.



RESULTS

The following shows the response rate of our survey.

TOTAL SURVEYED (100%)	350 administrators and teachers
Administrators surveyed	175
Teachers surveyed	175
RESPONDENTS (18%)	64 administrators and teachers
Administrators	17 (9%)
Teachers	47 (27%)

All open-response questions were analyzed by one coder, drawing heavily upon the *Framework for K-12 Education* (NRC, 2012) and other literature. A scoring rubric (Appendix B) for data analysis was created prior to start of data analysis. Codes for questions asking individuals to define STEM education and provide outcomes for STEM education were drawn from the *Framework* (2012) and the Next Generation Science Standards. The literature provided definitions of STEM education and a number of the outcomes, and analysis included identifying the presence or absence of elements of the STEM education definition and its outcomes provided in the literature. We also created new codes as key words and phrases emerged from the responses to open-ended questions that drew from respondents' personal experiences.

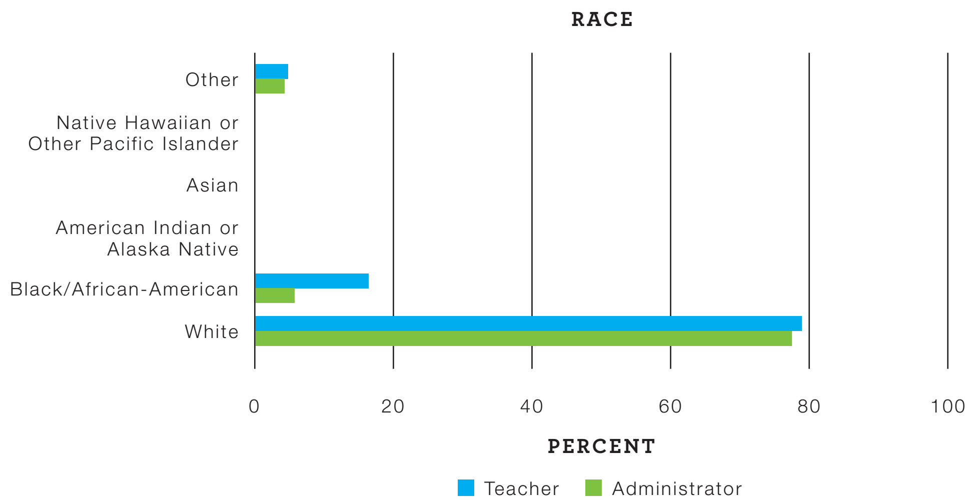
FINDING 1:

Teacher and administrator groups are similar in terms of background and perception of what STEM means.

When asked to give a definition of STEM education, teachers and administrators shared similar responses.

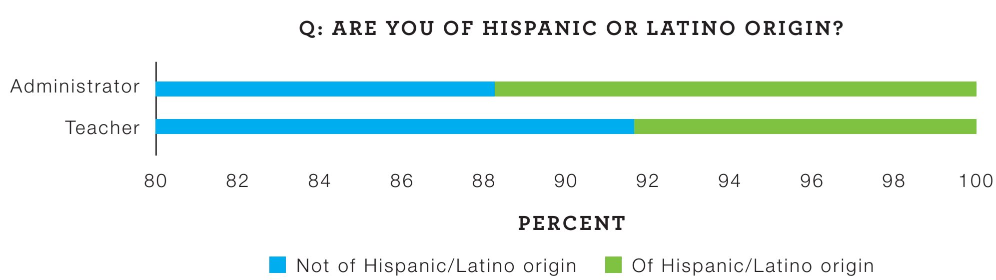
The teacher and administrator groups are similar demographically. For race and ethnicity, we adopted the item format used on the 2010 U.S. Census survey. They include White, Black/African American, American Indian or Alaska native, Asian, Native Hawaiian or other Pacific Islander, and Other as their categories, with the ability of selecting more than one option. The racial makeup of our survey respondents is dominated by White (76.5% for administrators, 78.7% for teachers), African American (5.9% administrators, 14.9% teachers), and Other (5.9% administrators, 6.4% teachers).

Figure 1. **Race of teacher and administrator respondents**



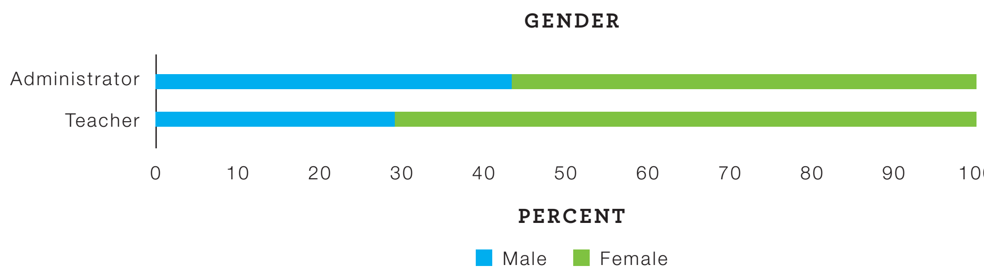
With both groups, there was a similar distribution of administrators and teachers who reported themselves as Hispanic/Latino (11% administrators, 8% teachers) (Figure 2). This was a separate question from the question regarding race, and we chose to mirror the item format used in the 2010 U.S. Census (United States Census Bureau, 2010). This question asks about an ethnic group that shares a common language and/or heritage but has different geneological backgrounds. A chi-square analysis found no difference between the makeup of the teacher and administrator groups at the p=.05 level[2].

Figure 2. **Respondents of Hispanic or Latino origin**



Also, with both groups, more females responded than males; however, the difference was greater in the teacher group (38.3% more females than male) than the administrator group (17.6% more females than male) (Figure 3).

***Figure 3.* Gender of respondents**



This difference was significant at the *p*=.05 level[2]. This is in line with the educator population of Illinois, who are approximately 33% more females than males (Illinois, n.d.). When we compared our survey respondent demographics with that of teachers and administrators in the state of Illinois (Illinois, n.d.), we found that the results were fairly representative (Table 1).

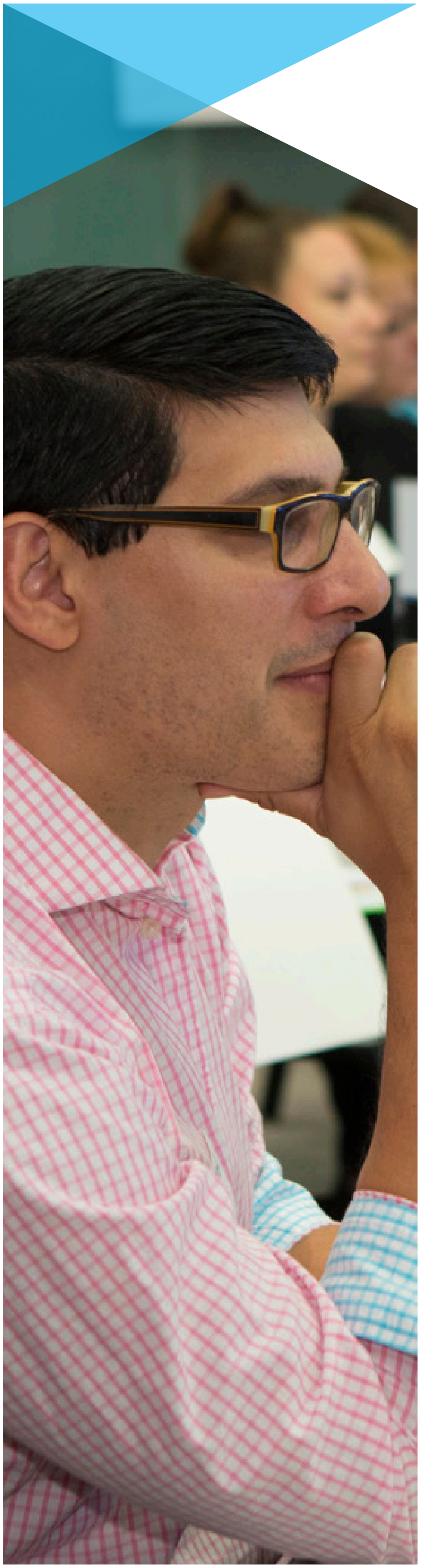
Table 1

Race Comparison of Educators in Illinois, Chicago Public Schools, and Survey Respondents

RACE	[1] IL EDUCATORS (%)	SURVEY RESPONDENTS (%)	[2] CHICAGO PUBLIC SCHOOLS (%)
White	83.6	80.6	49.7
African American/Black	6.6	12.9	24.3
Asian	1.4	0	3.4
American Indian	.2	0	.4
Other	6.8	6.5	1.9
Two or more races	.4	.03	1.8

[2] $t(df) = X, p=.05$

[1] Illinois State Board of Education (no date provided).
[2] *Stats and Facts*. Chicago Public Schools (no date provided).



We had about twice as many African-American respondents in our sample than teach in the state of Illinois. However, a possible explanation can be found when looking at census estimates (U.S. Census Bureau, 2014), the population of African-American individuals is more than 1.6 times larger in Cook County, Ill. than in the overall state of Illinois. Thus, our population is more representative of Cook County than Illinois as a whole. Demographic information is not available for teachers and administrators in Cook County, specifically; however, it is available for the Chicago Public Schools (CPS), the largest school district in the Chicago area and the third largest in the country. Our survey results mirror Illinois educators more than CPS educators, who have a lower percentage of white educators and a higher percentage of African-American educators. While CPS is the largest district in Cook County, there are 122 other school districts with varying distributions that help to contribute to the overall Illinois distribution.

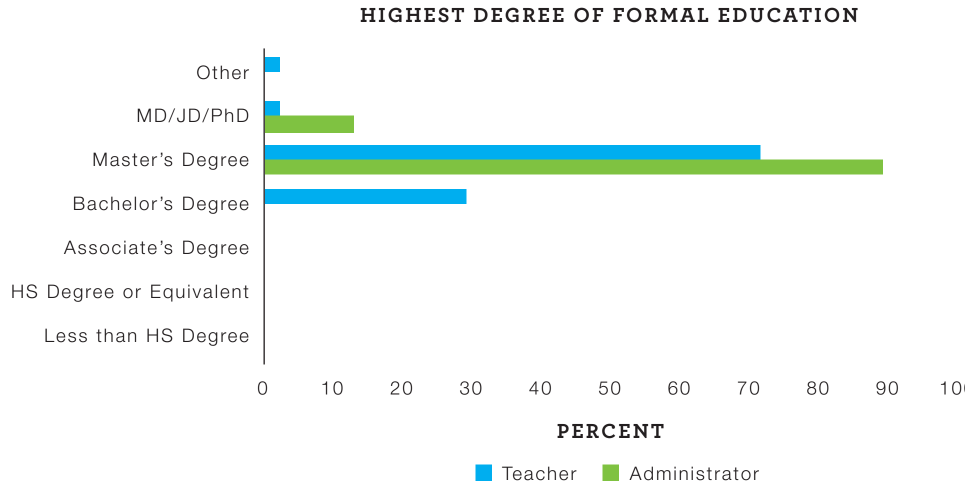
Table 2
Hispanic or Latino Origin of Illinois, CPS, and Survey Respondent Educators

	IL EDUCATORS (%)	SURVEY RESPONDENTS (%)	CHICAGO PUBLIC SCHOOLS (%)
Hispanic/Latino	3.6	9.0	18.6
Non-Hispanic/Latino	96.4	91.0	81.4

Our sample population also had over twice the percentage of Hispanic or Latino responses than in the state of Illinois (Table 2). This also could be explained by the higher number of Hispanic or Latino individuals living in Cook County than in the overall state, which is reflected in the much higher percentage of Hispanic and Latino CPS educators.

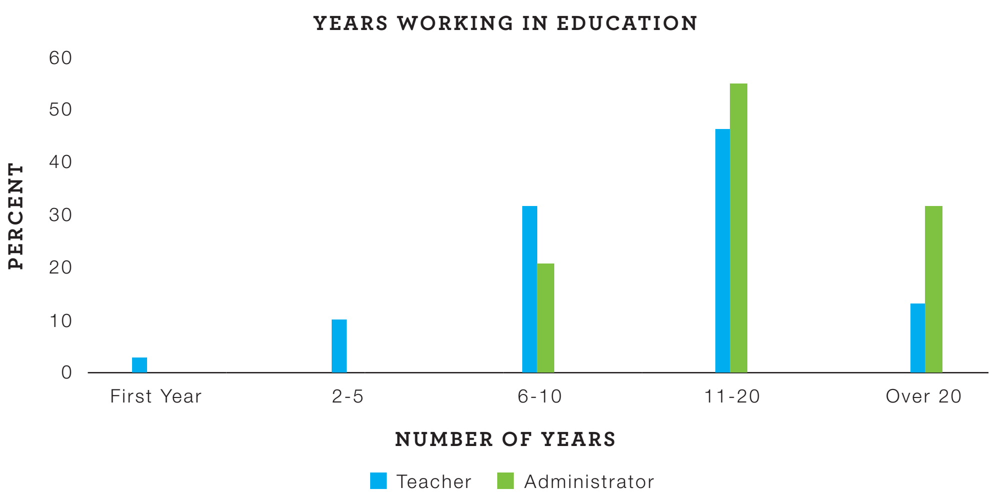
In terms of educational background, the teacher and administrator groups also looked similar (Figure 4). All teachers and administrators have obtained at least a Bachelor's degree. Administrators, as a group, have higher levels of formal education than teachers. All administrators reported having a Master's degree or higher. Eighty-eight percent of administrators report having a Master's degree, and 12% report having an MD, JD, PhD, or equivalent. Twenty-five percent of teachers report having a Bachelor's degree, 72% a Master's degree, and 2% an MD, JD, PhD, or equivalent.

Figure 4. **Highest degree of formal education of survey respondents**



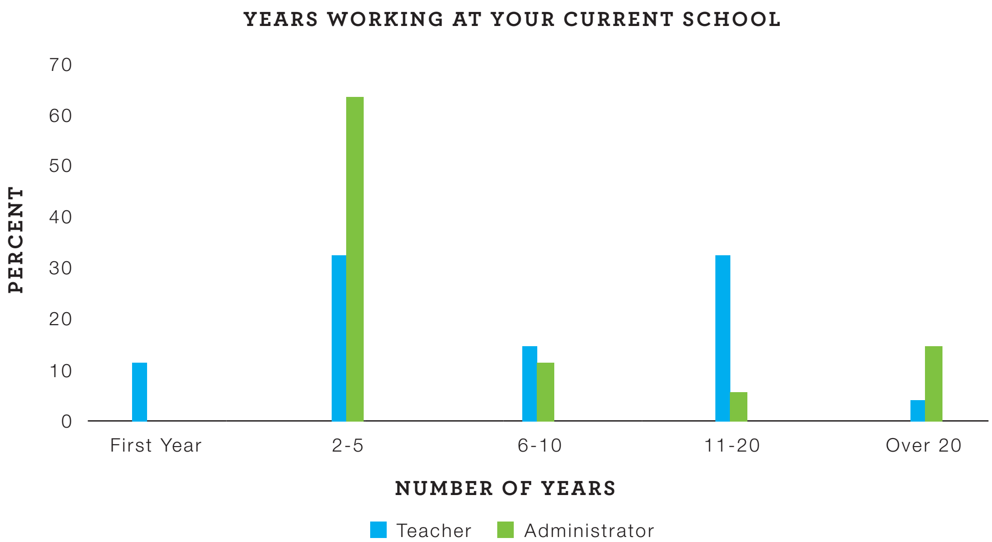
Professionally, the two groups are also similar in terms of career history. When asked "How many years have you been working in education?" A majority of survey respondents reported working in education for six or more years (Figure 5). The plurality of teachers (47%) and administrators (53%) indicated that they have been in education for 11 to 20 years. The teachers have a binomial distribution, peaking at 2 to 5 and 11 to 20 years, while the administrators have a negatively skewed distribution.

Figure 5. **Survey respondents' years working in education**



On average, administrators have worked in education for more years than teachers (11 to 20 vs. 6 to 10 years). Teachers and administrators have also worked similar years in their school (Figure 6). Survey data reflects the K-8 structure of many schools in the greater Chicago area.

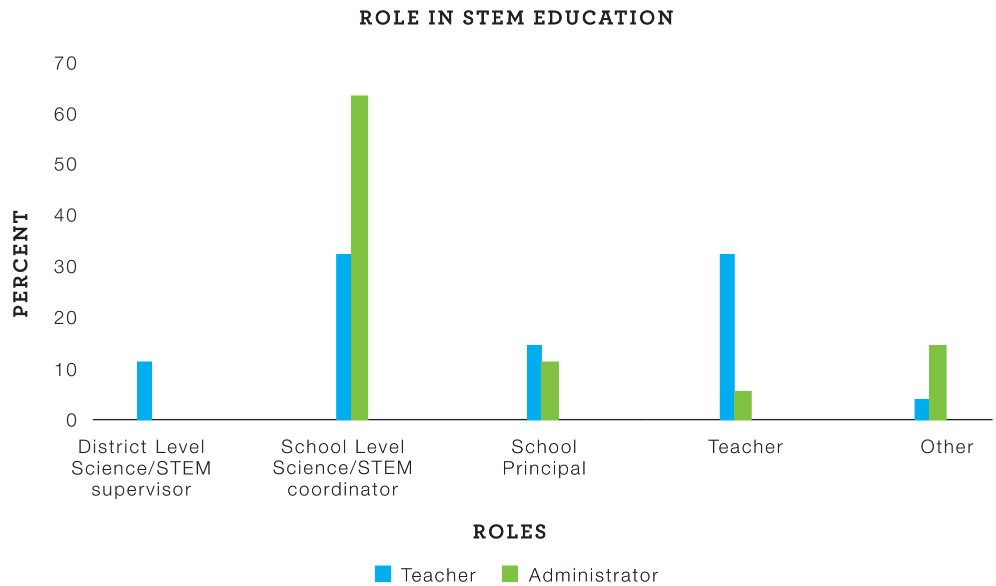
***Figure 6.* Survey respondents' years working at his or her school**



Most teacher and administrator respondents selected that they taught grades 6 to 8. One school also encompassed the high school grades (9 to 12). Most CPS and parochial elementary schools encompass pre-K to grade 8. However, suburban schools may be structured differently, and many have dedicated middle schools. The higher middle grades teacher response rate may be due to more respondents being from the suburbs than CPS or parochial schools.

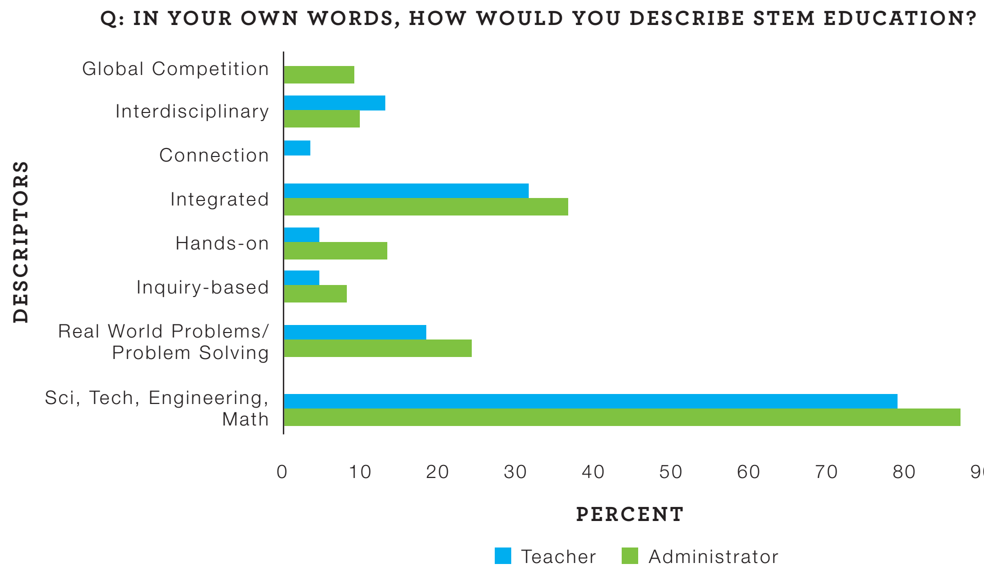
Lastly, when asked about their role in science or STEM education, all administrator respondents served as principals or an equivalent head of the school (Figure 7). All teachers reported that they taught a science class (whether self-contained or departmentalized) at their schools. Eleven percent of teachers reported that they were school-level science or STEM supervisors at their schools. In the Interactive Educational Systems Design National STEM survey of educators nationwide, close to 20% of respondents identified themselves as STEM coordinators and another 15% identified themselves as STEM supervisors (Interactive, 2012). The difference in response could be due to the fact that this is a newer type of position that many schools or districts in the Chicago area do not have.

***Figure 7.* Survey respondents' role in STEM education**



(Figure 8). When asked to give a definition of STEM education, teachers and administrators shared similar responses. The words "science," "technology," "engineering," and "mathematics" were included in responses shared between the two groups. Eighty-five percent of administrators and 76% of teachers used the entire phrase of "science, technology, engineering, and math" in their definition of STEM education. Using NSTA's definition of STEM (Tsupros, Kohler, & Hallinen, 2009) and key words from the *Framework for K-12 Education* (2012), we looked for common key words and phrases associated with definitions of STEM education and found eight consistent key words and phrases. The most commonly found were "integrated" (35% administrators, 29% teachers) and "real-world problems" or "problem solving" (23% administrators, 19% teachers). On average, administrators mentioned 1.7 of these characteristics of STEM and teachers used 1.4 when they defined STEM education.

***Figure 8.* Survey respondents' definition of STEM education**



In an open-ended question asking, "What are some examples of real-world out -comes for students who have an effective science or STEM education," teachers and administrators frequently responded with "job opportunity" or "career choice" (82% administrator, 49% teacher). Other common responses include "being able to understand scientific knowledge relating to their everyday lives" (47% administrators, 29% teachers), "being able to continue learning science outside of school" (47% administrators, 17% teachers), and having skills like "critical thinking and problem solving" (23% administrators, 21% teachers). These responses aligned with the goals and outcomes for students in the *Framework for K-12 Education* (2012). On average, of the five possible outcomes listed in the *Framework* (2012), teachers used 1.3 of these per example and administrators used 2.

Teachers and administrators also have similar ideas on how to support science and STEM education and what they feel is needed to adequately do so. Teachers and administrators agree that professional development for teachers should include defining STEM education, incorporate the Next Generation Science Standards (NGSS), be hands-on, include engineering, and model successful classroom and science education pedagogy. Administrators and teachers both felt that trained/qualified teachers were needed to provide quality STEM education. Top responses also included "spaces," "resources," and "materials." Both administrators and teachers said that they feel they can better support STEM education through more funding, quality professional development, and resources. Respondents did not elaborate on what types of resources they required. Top responses from the two groups also listed funding and access to resources as major challenges that their schools faced.

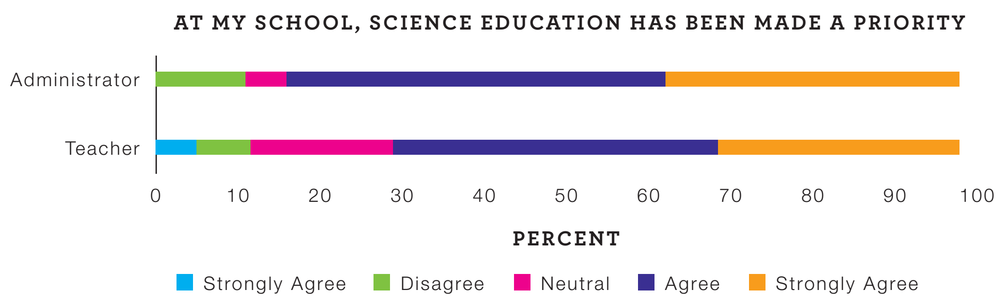
FINDING 2:

Teachers and administrators perceive that science and science education have been made a priority in schools.

More administrators felt that “Science knowledge is important in everyday life” than teachers.

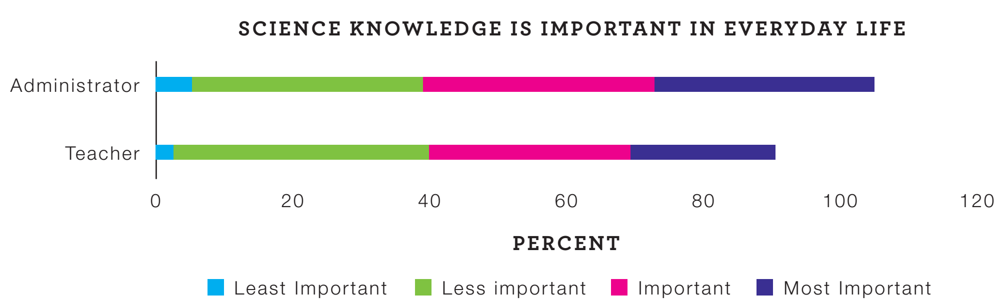
Both administrators and teachers indicated that they felt that there was support for science education already in their schools. However, more administrators than teachers indicated that they strongly agree, and more teachers than administrators indicated that they were neutral to the statement about support for science education at their school (Figure 9). According to a Mann-Whitney U test, the difference between the populations is not significant at the p=.05 level. We had a relatively low number of administrator responses (17). Upon visual inspection of the data, administrators appear more positive with their responses, with 82% agreeing and strongly agreeing with the statement, versus the teachers, who have a total of 70% agreeing and strongly agreeing. Additionally, no administrators selected strongly disagree, whereas 4% of teachers chose that designation.

***Figure 9.* Priority of science education**



More administrators felt that “Science knowledge is important in everyday life” than teachers (Figure 10). Twenty-nine percent of administrators felt that “science knowledge is the most important” in the acronym STEM while 35% felt selected important, with a combined total of 65%. Twenty-three percent of teachers felt science was most important, while 28% selected important, totaling 51%. Over half of respondents in both groups rated science knowledge as important or higher. According to a Mann-Whitney U test, the difference in the responses between the administrator and teacher populations was insignificant at a p=.05 level. Twenty-three percent of administrators responded that they did not always feel comfortable with science, feeling that their science content knowledge was lacking. However, responses showed that they were open to learning more about how to better support their teachers.

***Figure 10.* Science knowledge in everyday life**



FINDING 3:

Administrators and teachers perceive a difference in support from their non-science peers.

Administrators often said that their non-science peers want to know more about STEM education and how to do it.

Administrators feel more support from non-science peers than do teachers. As seen in Figure 11, 80% of administrators felt that their peers with non-science backgrounds had positive attitudes towards STEM education, versus 33% of teachers. Sixty-one percent of teachers versus 20% of administrators said their non-science peers had negative perceptions on STEM education.

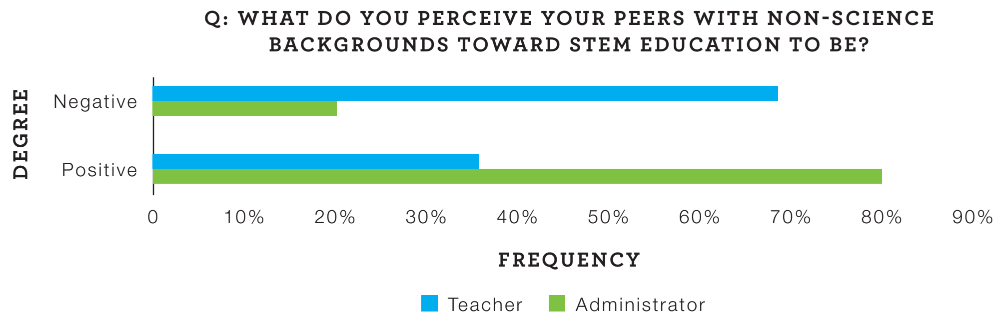


Figure 11. **Perception of attitudes of non-science peers toward STEM education**

Administrators often said that their non-science peers want to know more about STEM education and how to do it. Many responses included words like “positive,” “motivated,” “interested,” and “open-minded.” Perceived negative attitudes from their peers stemmed from not knowing enough about STEM education or not having enough time. However, teacher comments were more negative, often reflecting tha peers are more focused on Common Core subjects than science, and that science is just viewed as “fun” or an “extra subject” and that there is confusion over the term STEM. One respondent used the term “flavor of the month.” Another described STEM as being intimidating and confusing to their peers.

DISCUSSION

This survey study was designed to identify teacher and administrator perceptions and perceived value of STEM education, and to identify needed supports for STEM education in the greater Chicago area.

Important initial findings of the survey included similar backgrounds of teacher and administrator groups, similar responses of perceptions of and ideas to support STEM education, and a difference of perceived support from non-science peers between teachers and administrators. In the early stages of the Science Leadership Initiative, we noticed that our administrator and teacher focus groups often viewed themselves as distinct from each other. Each group believed that the collective other had vastly different thoughts and opinions on how to support STEM and science education, or that the other group was unaware of what to do. However, our survey results tell a different story. The two groups actually are more similar than not. Demographically, the teachers and administrators are very similar in composition, sharing similar racial backgrounds and gender distributions. When looking at the number of years in schools, administrators have spent less time in their current schools than teachers, while having similar career lengths, perhaps implying that administrators change schools more often. The distribution of the teachers shows that there is a high number who are newer to their schools, as well as a high number who have spent 11 or more years at that school. Survey respondents also shared similar challenges, needs, wants, and ideas in terms of support for science and STEM education.

While we found that the two groups were more similar than different, we did find some variation in their responses. These differences may be due to the nature of their positions. Administrators often had more strategic, whole-school suggestions, wants, and needs in supporting science and STEM education, whereas teachers had more responses relating to working on the front line, so to speak, with students. These can be attributed to the fact that administrators are often concerned about the operational nature of a school and curricula whereas teachers work more directly with students in the classroom. Administrators are not required to have science backgrounds, and through focus group discussions we found that many do not. This is also true of many elementary teachers who teach science. Many administrators and teachers felt they needed a better understanding of STEM education in order to provide better support for it at their schools.

On the importance of science and the priority of science at schools, administrators rated science as more important and of higher priority at their schools than teachers. There could be a number of reasons for this result. One potential reason could be due to the operational versus contextual differences revealed in responses. At a higher, strategic level, it may appear to a school administrator that there is a lot of support for the discipline of science at their school in comparison with other subjects; but, in the classroom context and at a teacher operational level, science support may not be as evident when you are teaching one or a few subjects. Both administrator and teacher responses have a negatively skewed distribution, meaning both felt that there was at least general support for science education at their schools. Additional comparisons between the importance of science versus

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technology, engineering, and mathematical knowledge were made in the survey, and there was very little difference in perceived importance between each of the STEM subjects. This was surprising, because all teachers surveyed taught science in their schools and science was not rated as most important.

When we asked teachers and administrators how they felt they were supported by their non-science peers, it was surprising that there was a higher number of positive responses of administrators and a higher number of negative responses of teachers. However, when analyzing through the lens of the strategic versus operational level contexts, a plausible explanation can be found. School administrators are concerned with the overall curricula that students are experiencing, along with achievement on assessments and standards like Common Core and Next Generation Science Standards. Teachers who do not teach science may be "siloed" within their own subjects and place less importance and priority on subjects that they do not teach or subjects that do not have yearly standardized assessments. This result has significant implications on the field of education and for the future of the Science Leadership Initiative. Even the staff within the same school may not have a shared understanding of what the school does to support science education for its students, much less between schools. This indicates an opportunity to provide support for school staff in increasing their awareness and understanding around science education through the use of a professional learning community (PLC).

This study has several limitations. Our survey study had a low response rate. A potential reason for the low response rate could be the timing of the survey corresponding to the beginning of the school year, late August to late September. It is also difficult to reach this population of responders, as teachers' and administrators' work schedules offer little free time during the work day. A charged political climate within the Chicago Public Schools regarding teacher evaluation may also have been a factor. Our small response rate could reflect a biased population, in that the most engaged in the topic were more likely to respond. We expect that the small incentive offered to participants attenuated this affect to some degree. Also, the open-ended responses of this survey were coded by one individual, not allowing us to determine its reliability.

CONCLUSION

Drawing from an extensive review on the research literature regarding supporting STEM education in K-8 schools, a survey was created to better understand the greater Chicago area school climate and potential participants of the Science Leadership Initiative programming. The data from this survey yielded three main results from teachers and administrators surveyed in the greater Chicago area:

1. Teacher and administrator groups have similar backgrounds and perceptions of STEM education.

2. Teachers and administrators both feel that science knowledge is important and should be a priority for students

3. Administrators and teachers perceive a difference in support from their non-science peers.

The open-ended qualitative questions will be used for developing the Science Leadership Initiative, including the creation of leadership professional development and other supports for program participants. This information will be published in a white paper in Spring of 2016.

The Science Leadership Initiative and its supporting components will eventually be housed within a specialized website (available at msichicago.org/science-leadership). As the initiative grows and develops, a grassroots network of education stakeholders will begin to emerge. This network will support the relationships that form among people who share common goals of advancing science teaching and learning at local schools. The Science Leadership Initiative participants will become an interconnected community of practice, providing support through mutual engagement and work, sharing resources, and highlighting their challenges and successes as they advance science education at their school site.

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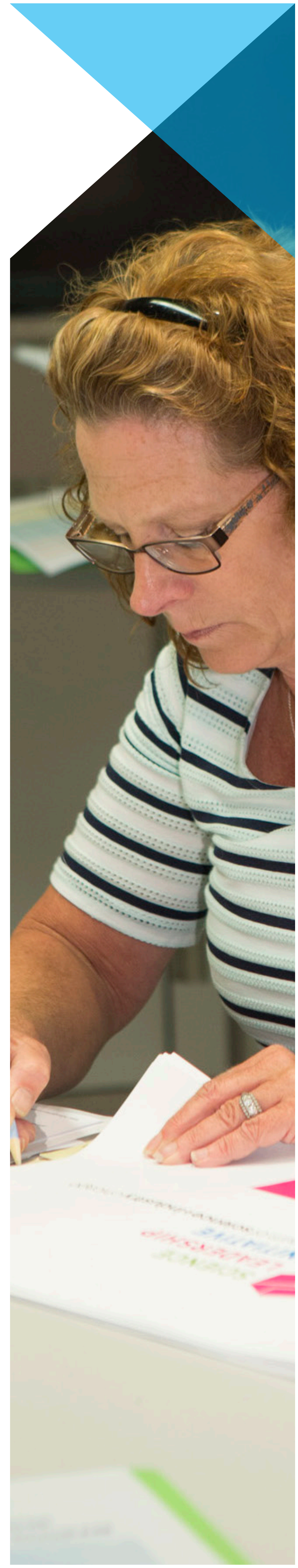

APPENDIX A

STEM PERCEPTIONS SURVEY QUESTIONS

1. In your own words, how would you define STEM education?

2. What are some examples of real-world outcomes for students who have an effective science or STEM education?

3. In what role do you primarily consider yourself?

- **A.** Teacher
- **B.** Administrator

TEACHER PAGE 2
Please rate the following items based on the degree to which you agree or disagree with each statement.
Strongly Disagree, Disagree, Neutral, Agree, Strongly Agree

4. At my school, science education has been made a priority.

5. I regularly use inquiry-based practices in my classroom.

6. My students engage in hands-on learning on a regular basis.

7. I feel comfortable with incorporating technology into my classroom lessons.

ADMINISTRATOR PAGE 2
Please rate the following items based on the degree to which you agree or disagree with each statement.
Strongly Disagree, Disagree, Neutral, Agree, Strongly Agree

4. At my school, science education has been made a priority.

5. I strategically allocate time for cross-curricular planning with my teaching staff.

6. It is my responsibility to support teachers' professional growth at my school.

TEACHER PAGE 3 (random, choose 4)

8. What do you think a classroom that integrates STEM looks like and feels like?

9. What are some ways STEM can be integrated across content areas?

10. In general, what do you think is needed to provide quality STEM education?

11. What are your non-science peers' perceptions on STEM education and why do you think this?

12. What are some examples of collaboration between science and non-science teachers in your school?

13. Why is understanding STEM education important to you?

14. What out of classroom experiences do you do right now to support STEM education?

15. How is your school integrating STEM education right now?

ADMINISTRATOR PAGE 3 (random, choose 5)

7. What do you think a school that integrates STEM looks like and feels like?

8. What are some ways STEM can be integrated across content areas?

9. In general, what do you think is needed to provide quality STEM education?

10. What are your non-science peers' perceptions on STEM education and why do you think this?

11. What are some examples of collaboration between science and non-science teachers in your school?

12. What are some partnerships (e.g. with community, non-profits, universities, businesses, industry, etc.), if any, that your school has formed to help further STEM education?

13. Why is understanding STEM education important to you?

14. How is your school integrating STEM education right now?

15. How do you feel you would be able to increase effective STEM education at your school?

16. What science teaching and learning practices do you expect your teachers to utilize in the classroom?

TEACHER PAGE 4
Please rate the following items based on the degree to which you agree or disagree with each statement.
Strongly Disagree, Disagree, Neutral, Agree, Strongly Agree

16. People must understand science because it affects their lives.*

17. Most people don't need to know much science. *

18. At what grades do you think science should be taught? ____________

19. Please rank the following statements from MOST IMPORTANT to LEAST IMPORTANT. Each answer may only be used once.
(1- Most important, 2- Important, 3- Less important, 4- Least important)

Science knowledge is important in everyday life
Technology knowledge is important in everyday life
Engineering knowledge is important in everyday life
Mathematics knowledge is important in everyday life

ADMINISTRATOR PAGE 4
Please rate the following items based on the degree to which you agree or disagree with each statement.
Strongly Disagree, Disagree, Neutral, Agree, Strongly Agree

16. People must understand science because it affects their lives. *

17. Most people don't need to know much science. *

18. I have short and/or long term goals involving improving STEM education at my school.

    A. No

    B. Yes (please elaborate) _________

19. At what grades do you think science should be taught? ____________

20. Please rank the following statements from MOST IMPORTANT to LEAST IMPORTANT. Each answer may only be used once. (1- Most important, 2- Important, 3- Less important, 4- Least important)

Science knowledge is important in everyday life
Technology knowledge is important in everyday life
Engineering knowledge is important in everyday life
Mathematics knowledge is important in everyday life

PROGRAM DEVELOPMENT (ALL)

21. Many schools have common resources. Please list some key resources you have at your school that support STEM education.

22. What are some challenges that you, personally, face on the way to supporting STEM education?*

23. What are some challenges that your school faces when supporting STEM education?

24. What do you feel YOU need to better support STEM education?

25. What kind of professional development FOR TEACHERS do you feel is needed to support STEM education?

26. What kind of professional development FOR ADMINISTRATORS do you feel is needed to support STEM education?

27. What are some organizations (community, non-profit, businesses, etc.) that provide the most valuable resources in support of STEM?*

28. What role or roles do you think a museum, such as MSI, should play in supporting STEM education in its community?

DEMOGRAPHICS

29. How many years have you been working in education?

30. How many years have you worked in your current school? (1, 2-5, 6-10, 11-20, 21+)

31. Grade level of instruction (K-2, 3-5, 6-8, HS)

32. Highest level of formal education (Less than HS, HS or equivalent, Associate's, Bachelor's, Master's, JD, MD, PhD, Other)

33. Gender

34. Role in STEM education? (District level science/STEM supervisor, School level science/STEM supervisory, School Principal, Teacher, Other)

35. What courses do you teach?

36. School name (optional)

37. Are you of Hispanic, Latino origin?

Yes No

38. What is your race? (select one or more answers)

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

SURVEY ANALYSIS SCORING GUIDE

Q1: In your own words, how would you define STEM education?
"…an interdisciplinary approach to learning where rigorous academic concepts are coupled with real-world lessons as students apply science, technology, engineering and mathematics in contexts that make connections between school, community, work and the global enterprise enabling the development of STEM literacy and with it the ability to compete in the new economy."

- Tsupros, N., Kohler, R., & Hallinen, J. (2009). STEM education: A project to identify the missing components. Intermediate Unit 1: Center for STEM Education and Leonard Gelfand Center for Service Learning and Outreach, Carnegie Mellon University, Pennsylvania.

Compare the definitions given with this definition of STEM education and that given by the Framework for K-12 Education by searching for the following keywords: 1) Science, Tech, Engineering, and Math, 2) Real world problems or problem solving, 3) Inquiry-based, 4) Hands-on, 5) Integrated or integration, 6) Connection, 7) Interdisciplinary, and 8) global competition. This definition is commonly used by the NSTA and other research groups for defining what STEM education is and hopes to achieve. Use 1's and 0's to indicate the presence or absence of that keyword within the definitions. This is hereafter referred to as "STEM Definition keywords".

Use 1 for yes, 0 for no presence of STEM Definition keywords (1-8 above)

Q2: What are some examples of real-world outcomes for students who have an effective science or STEM education?
Identify the presence (1) or absence (0) of the following outcomes provided in the NRC's Framework for NGSS:

1. All students to have some appreciation of the beauty and wonder of science'
2. Possess sufficient knowledge of science and engineering to engage in public discussions on related issues
3. Are careful consumers of scientific and technological information related to their everyday lives
4. Are able to continue to learn about science outside school
5. Have the skills to enter careers of their choice, including (but not limited to) careers in science, engineering, and technology

Use 1 for yes, 0 for no presence of STEM Definition keywords (1-5 above)

Q3: What do you think a classroom that integrates STEM looks like or feels like?
Identify most common words and phrases and their frequencies

Q4: What are some ways STEM can be integrated across content areas?
Identify most common words and phrases, frequencies.

Q5: In general, what do you think is needed to provide quality STEM education?
Identify most common words and phrases, frequencies.

Q6: What are your non-science peers' perceptions on STEM education and why do you think this?
Identify the alignment to the following:

1. I do not know
2. Their perception is like mine
3. Positive statement
4. Negative statement

Q7: What are some examples of collaboration between science and non-science teachers in your school?
Identify the most frequent words and phrases and compare all of the answers to these most frequent answers.

Q8: Why is understanding STEM education important to you?
Identify the presence or absence of the outcomes outlined in the Framework.

1. All students to have some appreciation of the beauty and wonder of science
2. Possess sufficient knowledge of science and engineering to engage in public discussions on related issues
3. Are careful consumers of scientific and technological information related to their everyday lives
4. Are able to continue to learn about science outside school
5. Have the skills to enter careers of their choice, including (but not limited to) careers in science, engineering, and technology

Use 1 for yes, 0 for no presence STEM Definition keywords (1-5 above)

Additionally, identify any common words and phrases and compare the presence or absence.

Q9: What out of classroom experiences do you do right now to support STEM education?
Identify the most frequent words and phrases and compare all to these.

Q10: How is your school integrating STEM education right now?
Identify the most frequent words and phrases and compare to these. Additionally, grade them weak, mid, or strong based on how the teacher constructs their response.

Likerts:
Average all likert responses. Additionally, add counts for each response choice by question.

Q11: At what grades do you think science should be taught?
Identify the most frequent responses and compare to these.

Q12: Ranking of the statements.
Convert all responses to their numerical value. Average and tally counts for each response by question.

Q13: Many schools have common resources. Please list some of the key resources you have at your school that support STEM education.
Identify the most frequent responses.

Q14: What are some challenges that you, personally, face on the way to supporting STEM education?
Identify the most frequent responses.

Q15: What are some challenges that your school faces when supporting STEM education?
Identify the most frequent responses.

Q16: What do you feel YOU need to better support STEM education?
Identify the most frequent responses.

Q17: What kind of professional development FOR TEACHERS do you feel is needed to support STEM education?

Q18: What kind of professional development FOR ADMINISTRATORS do you feel is needed to support STEM education?
Identify the most frequent responses

Q19: What are some organizations (community, non-profit, businesses, etc.) that provide the most valuable resources in support of STEM?
Identify the most frequent responses.

Q20: What role or roles do you think a museum, such as MSI, should play in supporting STEM education in its community?
Identify the most frequent responses.