Annual Implementation Plan for Pace University: Curriculum and Community Enterprise for the Restoration of New York Harbor with New York City Public Schools - Phase II

NSF Innovative Technology Experiences for Students and Teachers (ITEST) Project Award #1759006

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Executive summary

The Billion Oyster Project (BOP) Curriculum and Community Enterprise for Restoration Science (BOP-CCERS) in New York Harbor project aims to advance the efforts of the National Science Foundation (NSF) Innovative Technology Experiences for Students and Teachers (ITEST) program. The objectives of this CCERS ITEST project are to better understand and promote practices that increase student motivations and capacities to pursue careers in fields of science, technology, engineering, or mathematics (STEM) by expanding and testing an innovative curriculum model that features locally relevant, problem-based learning. This document provides an update to the progress of the research in understanding the influence of the ITEST program on students' motivations and preparation to pursue STEM careers.

Research team activities, achievements, and highlights in year 3:

Research activity	Summary
Project management	• The research team **met biweekly** with the evaluation team and BOP staff to discuss progress toward activities, instrument development, data collection, and data analysis. • The research team **completed Institutional Review Board (IRB) applications and received approval** of IRB renewal from the New York Department of Education and Pace University for year 3.
Data collection	• The research team **worked with BOP staff and partners** to collect data from students engage in BOP activities, activities with partners, and with the general public through social media. • BOP staff introduced the research and provided survey links at various events, such as teach professional development sessions, near peer mentoring career panels, STEM Hub workshops, and BOP newsletters. • **A total of 503 students accessed** a student survey link, with most accessing the survey between October 2020 and December 2020. • The **research team matched 111 survey responses** with parental consent and student assent to use for data analysis.
Data cleaning	• The research team **cleaned** student survey data and **developed** a codebook and research dataset.
Data analysis	• The research team **conducted preliminary analyses** for the three research questions using the **student pre-surveys** and a **document review of ITEST curricula and innovations**. Preliminary analyses of the data should be used to show insight to the students participating in ITEST activities.
Findings related to student learning	• The ITEST project has **developed a wide variety of curricula and innovations**, including development of the BOP Digital Platform, activities that can be used in classrooms and field settings, virtual classroom visits, and virtual panels with industry professionals. The curricula and innovations developed align with providing middle school and high school students with the **opportunities to learn science and research activities as well as engage with STEM professions to have a heightened awareness of STEM careers**.

Research activity	Summary
Findings related to STEM career interest	• On average**, ITEST respondents had a higher motivation, and interest in science** compared to the low-engagement comparison group, and **a higher scientific identity and intent to pursue STEM careers** than respondents who attended activities at the New York Aquarium. These findings suggest that ITEST is reaching students who have **high motivation and interest in STEM** careers. Additionally, **underrepresented student respondents on average had a higher interest in STEM and higher scientific identity** than non-URM respondents. However, they had a lower expectation of success in STEM and interest in STEM careers, indicating that URM respondents may need more support to feel more confident and aware of opportunities for them in STEM.
Findings related to student engagement & learning	• Document review of BOP curricula and innovations showed that BOP staff spent time at the beginning of the shelter-at-home orders in March 2020 in adapting activities for a virtual environment to continue to engage students during the pandemic. Survey responses indicated that **ITEST respondents on average had higher engagement in STEM** activities compared to the NY Aquarium respondents, but lower than STEM+C respondents. Additionally, **URM respondents had a higher number of activities they were engaged in compared to non-URM respondents**, but a lower number of total hours. Participating in ITEST activities may help to close this gap.

Next steps: In 2021, the research team will work with BOP staff and partners to help reach more students for student surveys, identify ways to increase parental consents of students, and administer post-surveys to students.

Background

Project and research overview

The Billion Oyster Project (BOP) Curriculum and Community Enterprise for Restoration Science (BOP-CCERS) in New York Harbor project aims to advance the efforts of the National Science Foundation (NSF) Innovative Technology Experiences for Students and Teachers (ITEST) program. The objectives of this CCERS ITEST project are to better understand and promote practices that increase student motivations and capacities to pursue careers in fields of science, technology, engineering, or mathematics (STEM) by expanding and testing an innovative curriculum model that features locally relevant, problem-based learning. The current CCERS ITEST project is the second phase that was awarded NSF funding for the duration between February 23, 2018 to February 28, 2022 (Award # = 1759006) and is currently in the third of five years of the project.

The curriculum model is organized around habitat restoration in New York harbor and engages students and teachers in a sequence of activities that span the middle and high school grades of the nation's largest urban school system. Because of the outdoors nature of the core STEM Hub activities, BOP was able to run limited, socially distanced in-person activities during the COVID-19 pandemic, and adapted activities for digital delivery. Students continue to conduct field research in support of restoring native oyster habitats with special emphasis on various science disciplines that include geology, biology and environmental sciences to bridge the scientific knowledge gap of these particular subjects in schools focusing on watersheds and the roles of keystone species.

The project is currently being implemented by a broad partnership of institutions and community resources, including Pace University, the New York City Department of Education, the Columbia University Lamont-Doherty Earth Observatory, the New York Academy of Sciences, the New York Harbor Foundation, the New York Aquarium, and others. This project builds on and extends the BOP library of learning materials of the New York Harbor School. Below demonstrates a map of the reach of the CCERS ITEST project.

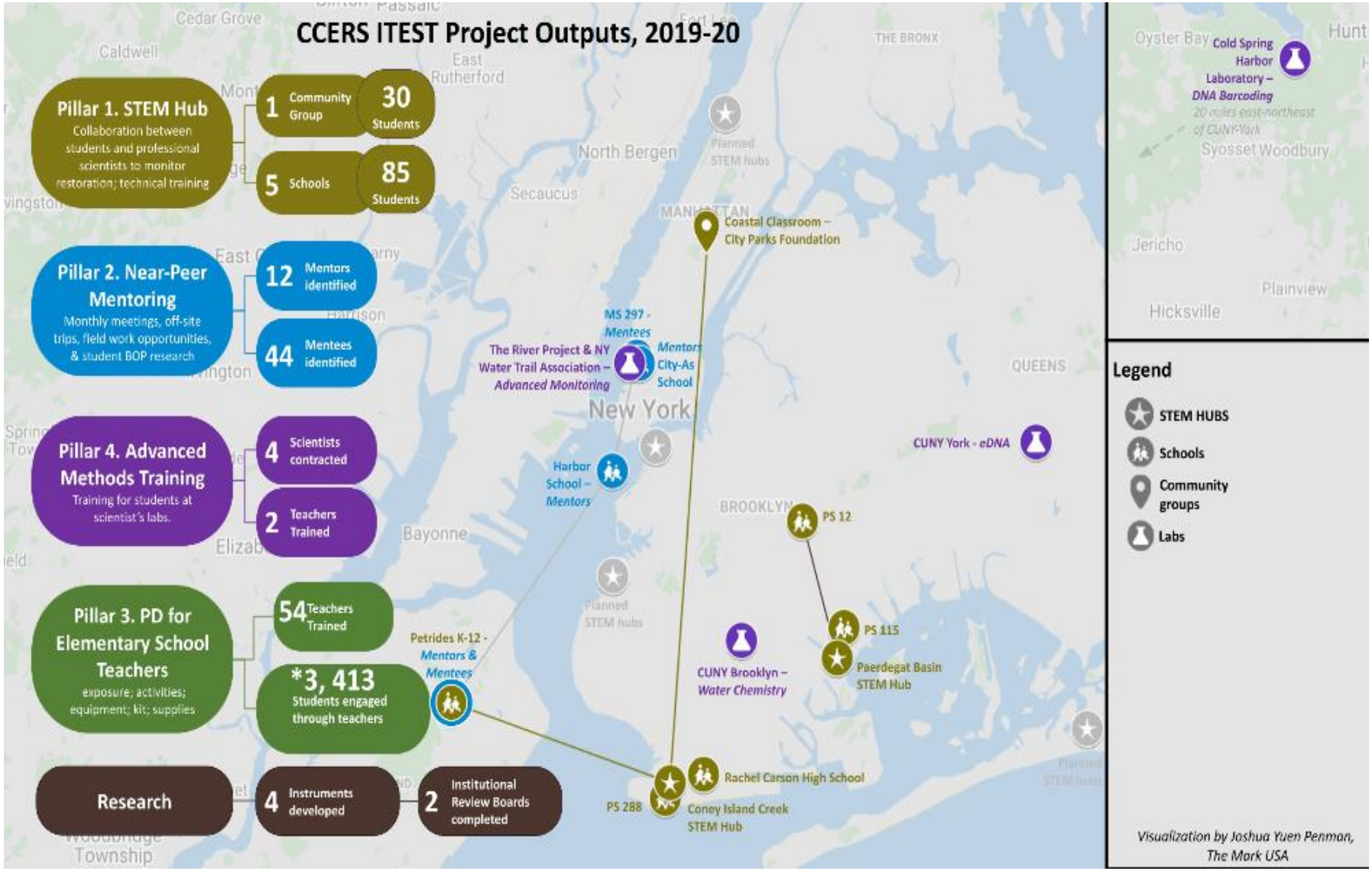


Figure 1. CCERS ITEST project outputs

Research objectives

As part of this project, the research team works with the evaluator, curriculum developers, digital platform administrators, and teachers to identify effective program aspects and assess the effectiveness of participation in various combinations of program components. The research team is exploring the following research questions:

- Research question 1: How does the CCERS Phase 2 project influence motivation and preparation to pursue STEM careers among K-12 students?
- Research question 2: What aspects of the CCERS Phase 2 project have a positive influence on underrepresented students' motivation and preparation to pursue STEM careers, compared to other students?
- Research question 3: What curricular innovations associated with the CCERS Phase 2 project contribute to heightened awareness of and intent to pursue STEM careers among students?

The research team collaborated with the project principal investigator and relevant stakeholders to identify the most feasible ways to embed data collection into the program activities and adapt to rapid changes in external circumstances. BOP staff introduced the research and provided survey links at various events, such as teach professional development sessions, near peer mentoring career panels, STEM Hub workshops, labs, and BOP newsletters. The "Research Planning Table" provides an overview of all events where the links were distributed. The research team plans to use multivariate analyses and qualitative data analysis to answer the three research questions listed above.

Research logic model

The research team worked with the project team to create a logic model (shown below) that depicts how the activities connect to the intended outcomes as part of the research.

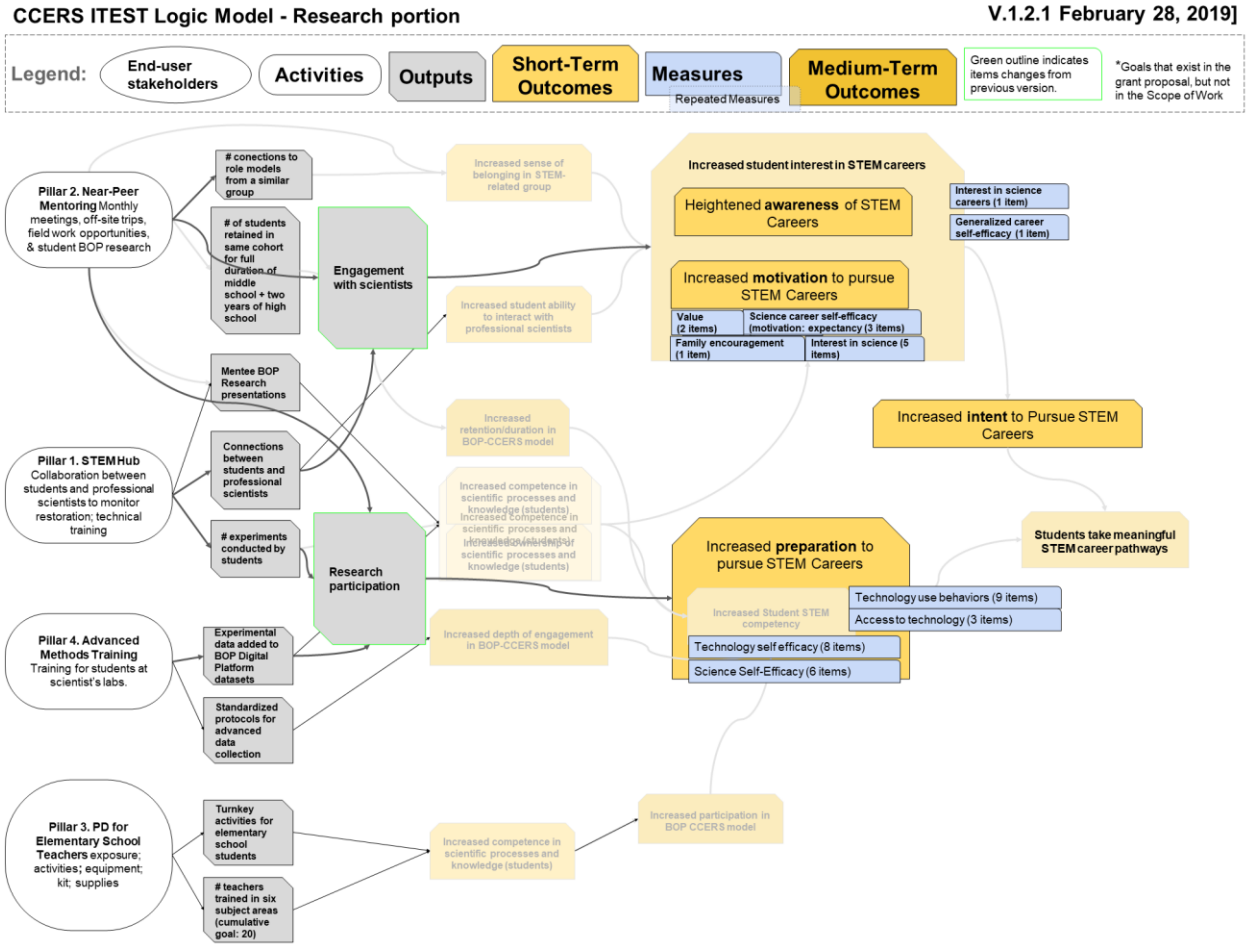


Figure 2. CCERS logic model research portion

Research design and instrument development

The research team conducted literature reviews and worked with the project team to develop metrics that align with the research questions. The table below illustrates how instruments and data collection align to the research questions. For a complete overview of how the instruments were developed see 2021-01-15 Master Instrument Deliverable (Codebook) for 2020 report in Appendix A. Instruments have been adapted to include feedback from the project team and partner. The most recent versions of the surveys can be found in Appendix B.

Research Question	Hypothesis	Data Collection Tools and Methods	Sample
How does the project influence motivation and preparation to pursue STEM careers among K-12 students?	Hypothesis 1 (H1): Science technology and research participation and engagement with scientists via CCERS ITEST positively influence motivation and	▪ Pre-post student survey which contains the i) **motivation to pursue STEM careers inventory (IE.1)**,[1] ii) **preparation**	Treatment group: Students who have participated in: ▪ Community Based

[1] The deliverable numbers correspond to those in the Table of Invoices and Deliverables in the ITEST SoW.

	preparation to pursue STEM careers for CCERS ITEST students	**for STEM careers inventory (1E.2)** ▪ Digital platform usage tracking ▪ Project participant tracking outside the digital platform (performed by BOP)	Restoration STEM Hubs ▪ Near Peer mentoring program ▪ Advanced methods training Comparison group: 1) Higher engagement comparison groups: a)STEM+C participants b) NY Aquarium students 2)Lower to no engagement activities (reached through general public or not exposed to BOP curriculum)
What aspects of the project have a positive influence on underrepresented students' motivation and preparation to pursue STEM careers, compared to other students?	Hypothesis 2 (H2): Science research participation and engagement with scientists via CCERS ITEST positively influence motivation and preparation to pursue STEM careers among underrepresented groups	▪ Measurement tools listed for RQ1 above ▪ Engagement with scientists inventory (**1E.3)** and/or engagement metrics from BOP online platform and participant tracking ▪ Underrepresented groups inventory to identify those who are underrepresented minorities (determined by those who self-identify as non-white or non-Asian), low income, or for whom English is not a first language.	
What curricular innovations associated with the project contribute to heightened awareness of and intent to pursue STEM careers among students?	Hypothesis 3 (H3): CCERS models of engagement (including Bybee's 5E model and problem-based learning) enhance awareness of and intent to pursue STEM careers among K-12 students in New York	▪ Measurement tools listed for RQ1 above ▪ Intent to pursue STEM careers inventory ▪ Awareness of STEM Careers inventory ▪ Document review of CCERS models of engagement (ex. Bybee's 5E model; problem based learning) to determine dosage and/or a **dosage check inventory** in survey.	

Figure 3. Research plan

The current report includes analysis of responses from four groups: ITEST (treatment group), STEM+C (high-engagement comparison group), NY Aquarium (high-engagement comparison group) & Comparison group (low to no engagement).

Data collection

In year 2, the research team obtained the IRB approval from both the New York Department of Education (NY DoE) and Pace University and the approval of IRB renewal from the New York City Department of Education and Pace University for year 3. Researchers modified instruments and worked with evaluators and the project team to administer the surveys. The research team

provided partners with a default survey link,[2] that could be used by anyone, and with survey links tied to specific activities. The default link was used by the Billion Oyster Project. PACE University and the research team shared a link for applicants to the STEM+C summer institute, and another for participants in a STEM Hackathon at the beginning of December. The majority of responses come through the default link, which is shared publicly in order to obtain as diverse a sample as possible. Due to IRB restrictions, only middle school and high school students were surveyed.

Maximum step complete:[a]	# responses
5 with all consents	**94**
5 - Missing evaluation step	**8**
5 - Missing Student Assent	1
5 - Missing Parental Consent	38
5 - Missing evaluation and parental consent	6
4: Completed evaluation with all consents	**17**
4 - no assents	30
4 - missing student assent	3
4 - missing Parental Consent	23
3 - stopped at student assent, missing parental consent	10
3 - stopped at student assent	1
2 - stopped at parental consent	43
1 - stopped at pre-approval	229
Grand Total	**503**

a. Items bolded are what are included in the research dataset

Figure 4. Number of student survey responses (clicks, partials, and completions) by survey step

Clicking on the survey link would start the respondent on a 6-step process:

- Step one: A landing page, which was the introduction to the survey and included screening questions for pre-approval of participants
- Step two: Obtain parental consent for their child to participate in the research
- Step three: Obtain student assent, where the student provides their consent to participate in the research study
- Step four: An evaluation survey, that captured which activities the respondents engaged in and included questions developed by the evaluation team to collect feedback on the activities
- Step five: Research survey, which included questions specific to the research study
- Step six: Reward page, where the respondent received a certificate or an incentive for completing the survey

[2] A default survey link is used to minimize researchers' contact with personally identifiable information. It allows partners to share the link with activity participants directly and obtain more diverse responses than an email survey campaign. However, it also means that researchers do not have access to student email addresses and cannot track response rates.

Multiple surveys are used in order to separate personally-identifying information from responses. A total of 503 students opened the survey through one of the links to arrive at the landing page in Step 1. A total of 111 respondents completed all the necessary steps to complete the surveys, which included providing a parental consent, an important IRB stipulation for responses to be included in the research analyses.

The data collection efforts continued in year 3 of the project in addition to applications for the IRB renewal, in addition to further instrument refinements based on project partner requests and the analyses of preliminary data. BOP staff and their external partners walked students through the survey process and administered the surveys through the default link. Data were collected in a way to ensure that student information was kept confidential. Default survey links were shared with project staff to relay to event participants upon completion and data is collected on an on-going basis from the participants that the survey was shared with. In instances where a BOP activity occurred, a noticeable spike in the number of responses was recorded (July, October, and December). To collect comparison group data, links were distributed to STEM+C Summer Institute, STEM Hack-A-Thon, and NY Aquarium participants. The links and promotional materials were also sent to BOP contacts, partners and BOP mailing lists throughout the year. For specific information about the links and detailed data collection timeline, see "Research Planning Table V2 – ITEST."

The figure on the following page shows the completion status of surveys on the left-hand side and a breakdown by activity on the right. This demonstrates how BOP staff and partners have distributed links to students to collect responses for the surveys. As the chart depicts, large spikes tend to coincide with ITEST or STEM+C activities. Notably, a large portion of the responses came in October and December 2020.

Figure 5. Comparison of survey completions and referral links by dates

Data analysis

Researchers matched pre-survey responses with parental consent and survey response data. This report includes only responses from those who provided both student assent and parental consent per the IRB requirement. A total of 111 students with parental consent and child assent completed the research and evaluation surveys (step 4 & step 5).

For Research Question 1, the sample was divided into the ITEST respondents (ITEST Ph2) who attended all ITEST activities; and three comparison groups 1) respondents who participated in STEM+C activities (STEM+C), 2) respondents who participated in activities at the New York Aquarium (NY Aquarium), and 3) those who completed the survey using a general link. These groups represented two higher-engagement groups who attended activities at PACE University (STEM+C) and the New York Aquarium, and a lower-engagement group of other students. Please note that the sample size may vary in different sections because not every respondent answered every question (or an "N/A" option was chosen). For Research Question 2, the sample was divided into underrepresented minority (URM), non-URM respondents, and those who did not provide any race/ethnicity data. For each of those two research questions, indices were created by averaging or totaling items from the survey. The research team presented means and standard deviations of the indices for each of the groups identified. Indices were created according to the instrument deliverables attached in Appendix A. The research team also provided the frequencies for all individual survey items by the treatment and comparison groups, which can be found in Appendix D.

For Research Question 3, the research team reviewed documents on BOP activities to assess how the curricula and innovations addressed career awareness and interest.

Limitations to the data: Only six respondents indicated on the survey that they participated in a BOP ITEST-related activity. This number is likely higher than indicated since 47 students accessed the link through a general link around the time of BOP events, but participation in ITEST was not confirmed. Therefore, in this report, they are considered part of the general comparison group. The research team will work with BOP staff to modify the post-survey to confirm BOP ITEST participation and modify the research survey in general to capture BOP ITEST participation.

Respondent demographics

	Comparison Group (n=72)		NY Aquarium (n=23)		ITEST (Ph2) (n=5)		STEM+C (Ph3) (n=11)		Total (n=111)	
	#	%	#	%	#	%	#	%	#	%
Gender										
Do not wish to specify	1	2%	-	-	-	-	-	-	1	1%
Female	23	51%	8	57%	3	75%	6	67%	40	56%
Male	21	47%	6	43%	1	25%	3	33%	31	43%
Total Gender	**45**	**100%**	**14**	**100%**	**4**	**100%**	**9**	**100%**	**72**	**100%**
Ethnicity										
Asian	8	18%	2	14%		-	4	40%	14	19%
Black or African American	9	20%	3	21%	1	25%	2	20%	15	21%
Hispanic/Latino	11	24%	4	29%	1	25%	2	20%	18	25%
Pacific Islander or Native Hawaiian	1	2%	-	-	-	-	-	-	1	1%
White (non-Hispanic or Latino)	12	27%	4	29%	2	50%	2	20%	20	27%
Other - Please specify[a]	4	9%	1	7%	-	-	-	-	5	7%
Total Ethnicity	**45**	**100%**	**14**	**100%**	**4**	**100%**	**10**	**100%**	**73**	100%
URM status										
No Data	28	39%	9	39%	1	20%	1	9%	39	35%
Non-URM	8	11%	2	9%	-	-	4	36%	14	13%
URM	36	50%	12	52%	4	80%	6	55%	58	52%
Total URM status	**72**	**100%**	**23**	**100%**	**5**	**100%**	**11**	**100%**	**111**	**100%**

a. Other includes South Asian/South American, White and Latino, and no specification

Figure 6. Breakdown of respondent demographics by participant group

Research question 1: How does CCERS influence motivation and preparation to pursue STEM careers among K-12 students?

Motivation to pursue STEM careers (STEM career interests)

Interest in science

Respondents answered four questions on a Likert-scale with ratings from 1=strongly disagree to 5=strongly agree regarding their interest in science, which were averaged to compute an index. Example items in the index included "I want to understand science" and "I like to see how things are made." On average, the ITEST group expressed higher interest in science ratings (M=4.17, SD=0.52) over the comparison group (M=3.96, SD=0.74) but their ratings were lower than those of the NY Aquarium comparison group (4.40, SD=0.86).

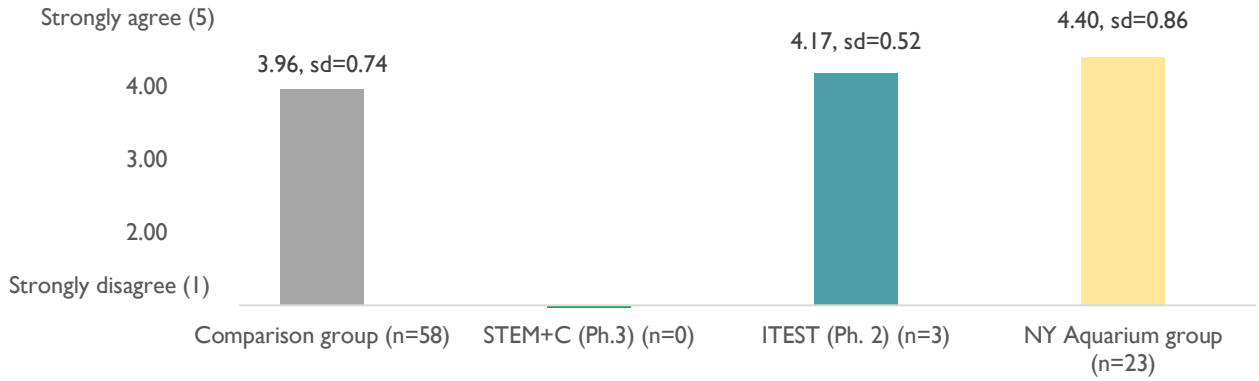


Figure 7. Respondents' average rating of interest in science by group

Expectation of success (expectancy)

Respondents answered two questions on a Likert-scale with ratings from 1=strongly disagree to 5=strongly agree which were averaged to compute an index. These questions included "Science is hard for me compared to most other students" and "I will have a successful professional career and make substantial scientific contributions." On average, the ITEST group expressed a higher expectancy rating (M=4.00, SD=1.00) over the comparison group (M=3.93, SD=0.88) but their ratings were lower than the average of the STEM+C group (M=4.23, SD=0.41) and slightly lower than the NY Aquarium comparison group (M=4.04, SD=1.07).

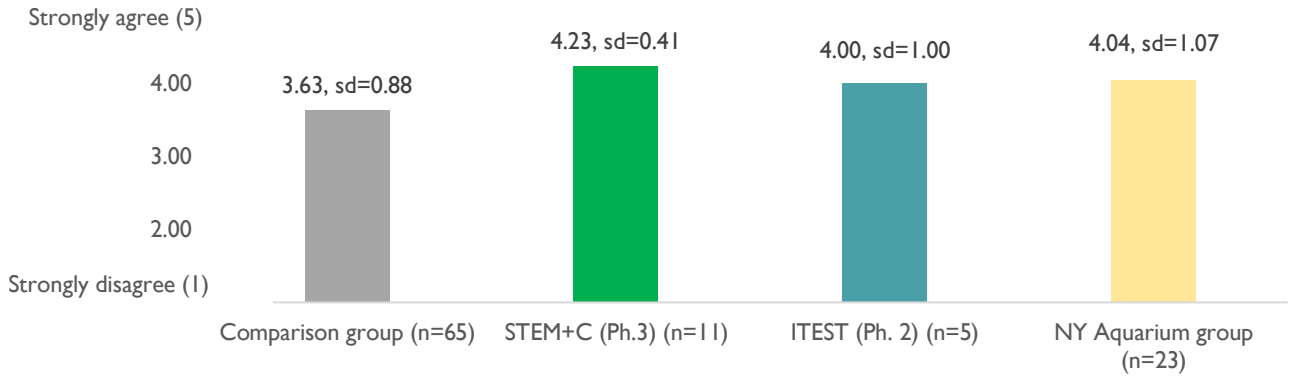


Figure 8. Respondents' average rating of engagement with scientists that contribute to their expectation of success

Scientific identity (motivation)

Respondents answered two questions on a Likert-scale with ratings from 1=strongly disagree to 5=strongly agree regarding their scientific identity, which were averaged to compute an index. Items in the index included "I have a sense of belonging to a community of scientists" and "I find it personally satisfying to work on a team that is doing research." On average, the ITEST group expressed a higher sense of scientific identity (M=4.13, SD=0.85) over the comparison group (M=3.39, SD=1.02) and the NY Aquarium comparison group (M=4.00, SD=0.98) but their ratings were lower than the average of the STEM+C group (M=4.25, SD=0.59).

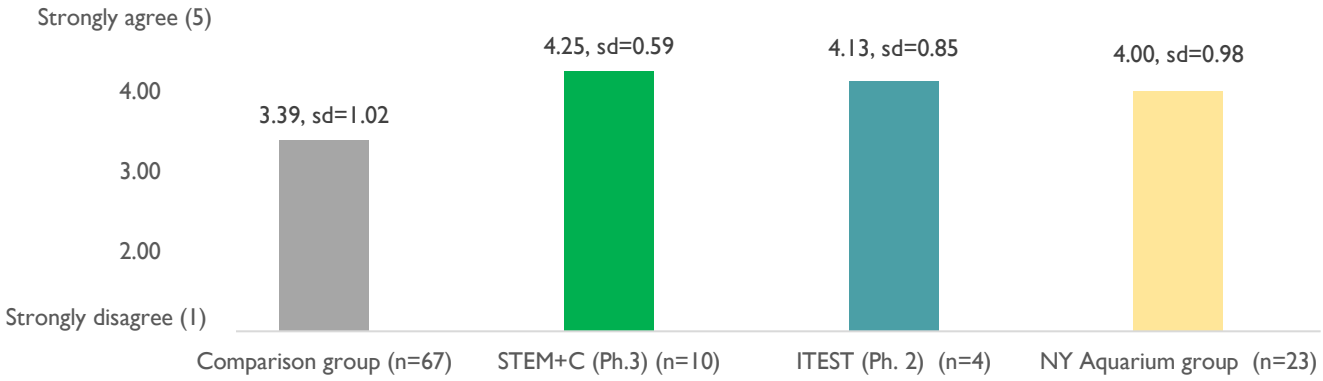


Figure 9. Respondents' average rating of scientific identity by group

Increased awareness of and intent to pursue STEM careers (STEM career interests)

Interest in broad STEM careers

Respondents answered four questions on a Likert-scale with ratings from 1=strongly disagree to 5=strongly agree regarding their broad interest in careers related to STEM fields (science, technology, engineering, and math), which were averaged to compute an index. On average, the ITEST group expressed a higher interest (M=3.84, SD=0.78) over the comparison group (M=3.20, SD=0.75) and the NY Aquarium comparison group (M=3.35, SD=0.95) but their ratings were lower than the average of the STEM+C group (M=4.36, SD=1.03).

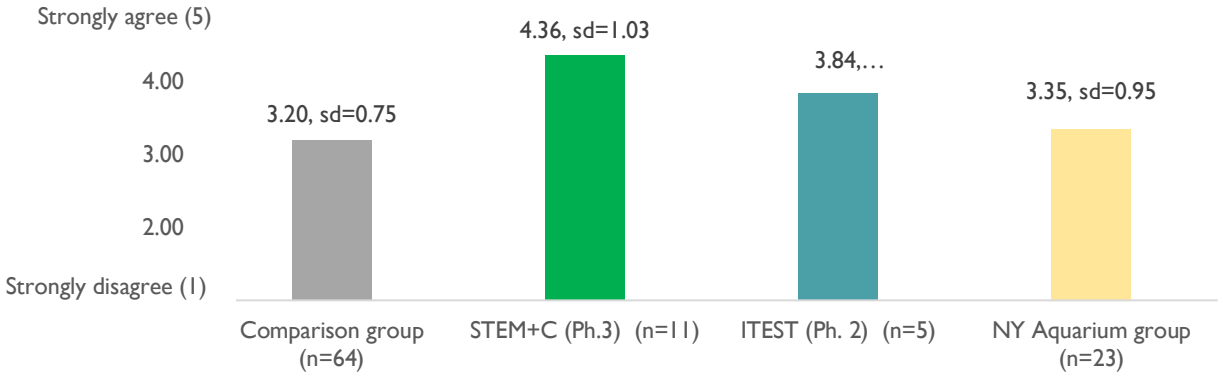


Figure 10. Respondents' average rating of interest broad STEM careers by group

Interest in specific STEM job titles

Respondents answered eight questions on a Likert-scale with ratings from 1=strongly disagree to 5=strongly agree regarding their interest in STEM job titles (e.g. "Hydrologist," "Biological Technician," "Wastewater Engineer"), which were averaged to compute an average index (Avg. index) and another indicator for the maximum (MAX index) was also calculated and contrasted by group type. The average index for interest in STEM job titles provides the mean student response regarding their broad interest in STEM job titles. In contrast, the maximum index for interest in STEM job titles highlights the students' maximum interest in any of the pre-defined STEM job title options.

Interest in STEM job titles (Avg. index)

On average, the ITEST group expressed a higher interest in specific STEM job titles (M=3.42, SD=0.74) over the comparison group (M=3.05, SD=1.00) and the NY Aquarium comparison group (M=2.76, SD=1.19) but their ratings were lower than the average of the STEM+C group (M=3.67, SD=1.05).

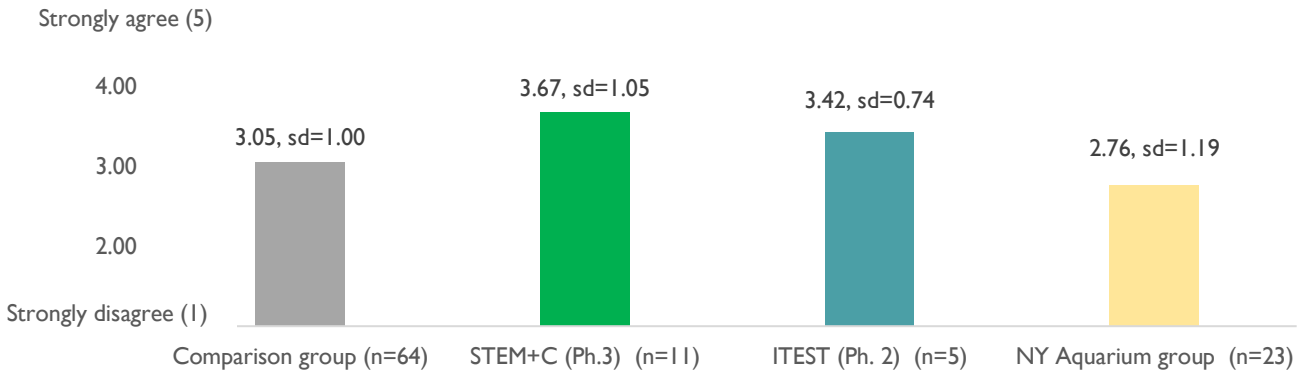


Figure 11. Respondents' average rating of interest in specific STEM job titles by group

Interest in STEM job titles (MAX index)

When examining the highest-rated STEM job title among all job titles presented, the ITEST group expressed a higher interest in STEM job titles (M=3.60, SD=2.07) over the comparison group

(M=3.28, SD=1.55) and the NY Aquarium comparison group (M=3.30, SD=1.33) but their ratings were lower than those of the STEM+C group (M=4.36, SD=1.03).

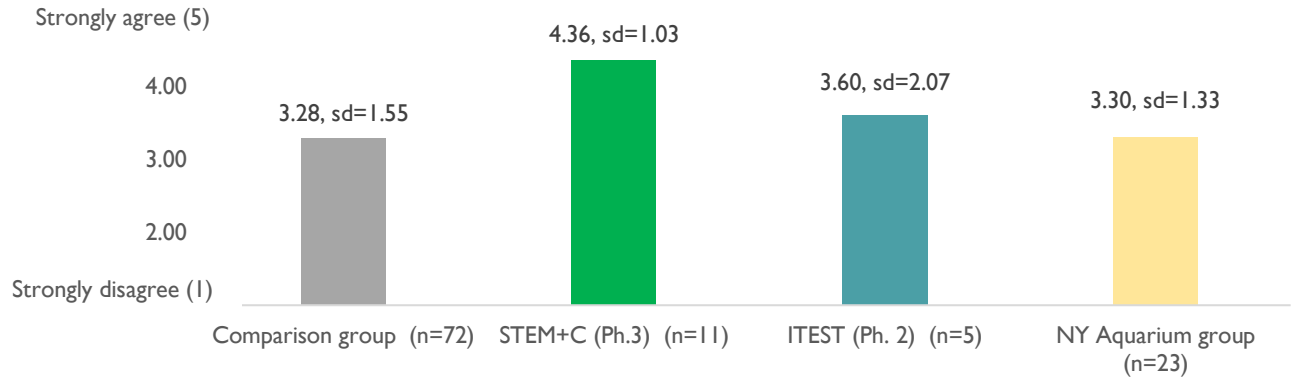


Figure 12. Respondents' average max rating of interest in specific STEM job titles by group

Intent to pursue a STEM career

Respondents answered one question, "To what extent do you intend to pursue a [career in science, technology, math, or engineering]?" on a Likert-scale with ratings from 1=definitely will not to 5= definitely will regarding their broad intent to pursue a STEM career. On average, the ITEST group expressed higher intent (M=4.00, SD=1.00) over the comparison group (M=3.46, SD=1.23) but their mean rating was lower than those of the NY Aquarium comparison group (M=4.50, SD=0.86) and the STEM+C group (M=4.45, SD=0.82).

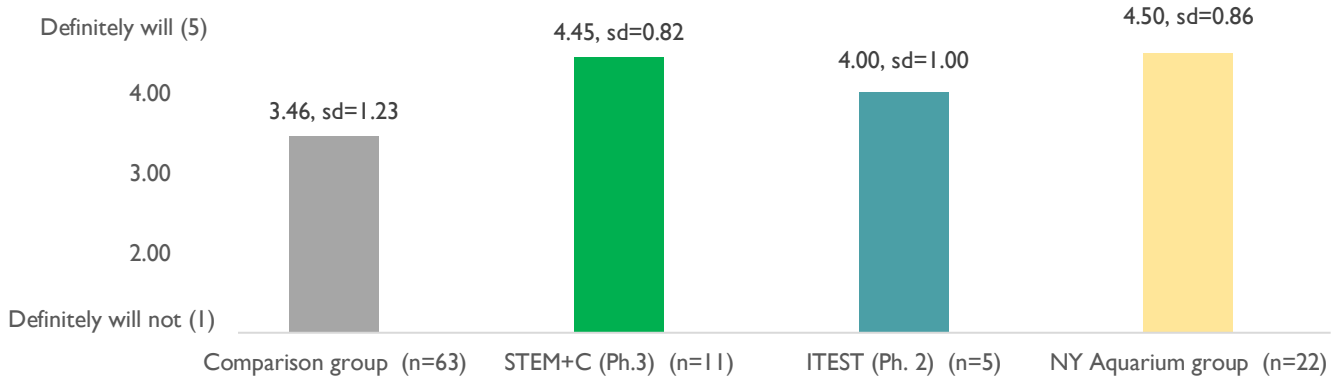


Figure 13. Respondents' average rating of intent to pursue STEM career by group

Engagement with scientists (engagement)

General engagement

Respondents answered one question on a Likert-scale with ratings from 1=not at all engaged with scientists to 5=extremely engaged with scientists regarding their general engagement with scientist. On average, the ITEST group expressed a higher general engagement level with scientists (M=3.00, SD=0.82) over the comparison group (M=2.87, SD=1.20) but their mean rating was lower than that of the STEM+C group (M=3.40, SD=0.97) and slightly lower than that of the NY Aquarium comparison group (M=3.04, SD=1.22).

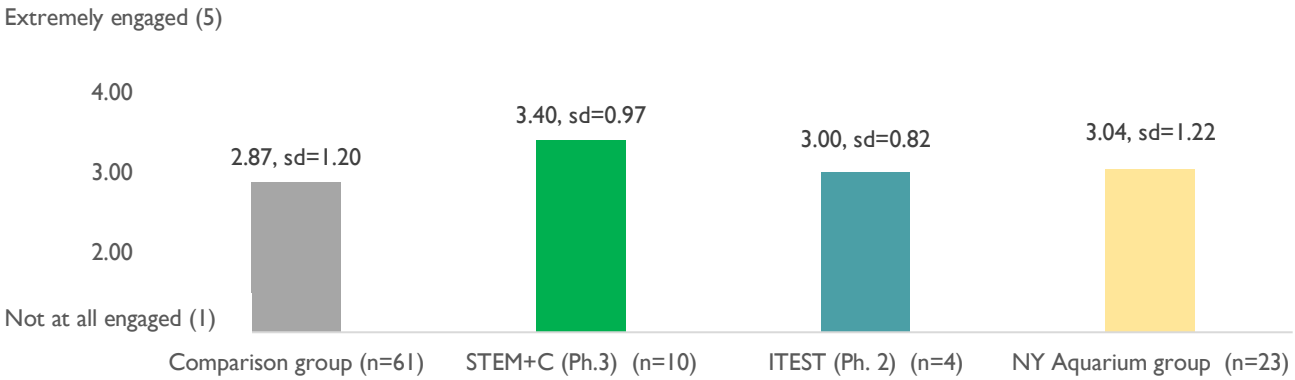


Figure 14. Respondents' average rating of general engagement with scientists by group

Direct projects

Respondents answered questions on whether they worked on direct projects with scientists, the number of directed projects they worked on, and the number of hours they spent on those projects. Overall, a higher percentage of the NY Aquarium group (35%) engaged in direct projects with scientists compared to the other groups, followed by ITEST respondents (25%) Only one comparison group respondent shared how many projects (2) and hours spent on the projects (2) and two STEM+C respondents (average of 5 projects for 2.5 hours). None of the ITEST or NY Aquarium group indicated the number or number of hours spent on projects.

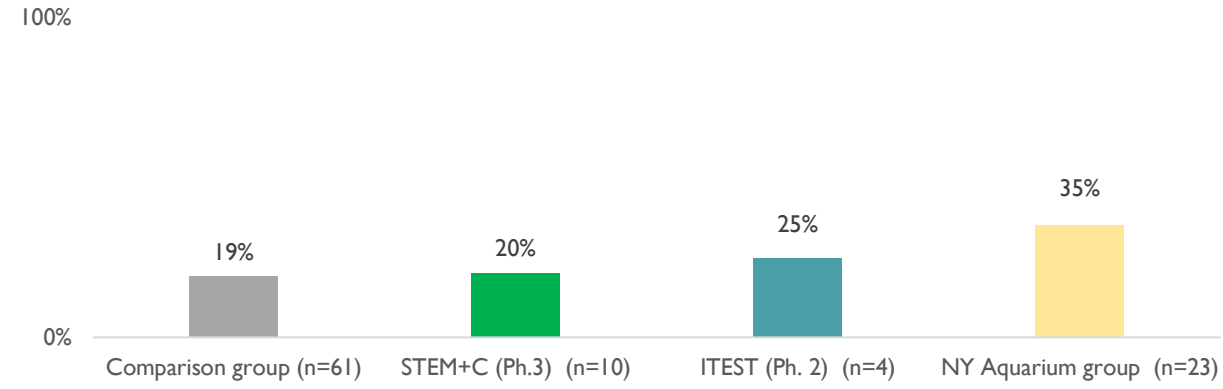


Figure 15. Percentage of respondents who indicated "yes" that they worked on direct projects with scientists by group

Number of activities engaged in

Respondents answered questions on the number of 26 possible activities they participated in the past 12 months (e.g., extracurricular activities involving robotics or engineering, volunteered in a science, technology, engineering and/or math field, volunteered in a field related to environmental cleanup and restoration, or participated in any science fairs or tournaments). The ITEST group reported a higher average number of activities (M=1.80) than both the Comparison group (M=1.24) and the NY Aquarium group (M=0.61) but their average was lower than the average activities reported by the STEM+C group (M=2.73).

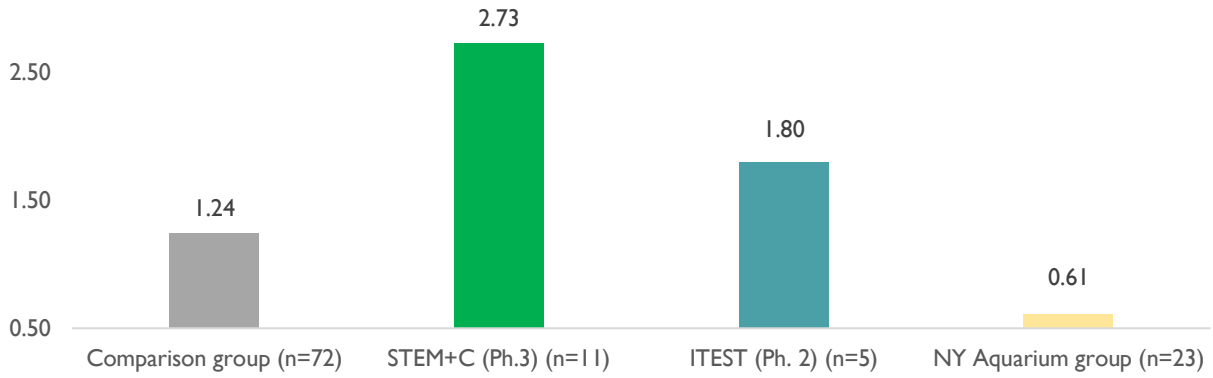


Figure 16. Respondents' average number of activities engaged in

Engagement with scientists – family or acquaintances

To assess context for a successful career, respondents answered two questions as to whether they have family members or acquaintances who are scientists to compute an average index by group. The ITEST group reported a higher average number of family or acquaintances (M=1.20) than both the Comparison group (M=0.18) and the NY Aquarium group (M=0.00) but their average was lower than the average context reported by the STEM+C group (M=1.73).

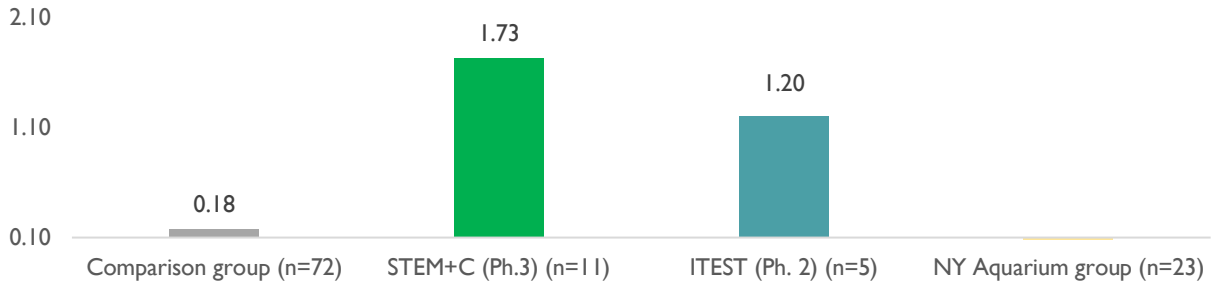


Figure 17. Average engagement with family members or acquaintances who are scientists by group

Research question 2: What aspects of CCERS Phase 2 have a positive influence on underrepresented students' motivation and preparation to pursue STEM careers, compared to other CCERS students?

Researchers explored differences between URM and Non-URM respondents using two representative outcome variables to understand how the project may influence URM students differently. Due to the small sample of ITEST participants who completed the survey, this analysis was conducted using all groups – ITEST, STEM+C, NY Aquarium, and the Comparison group. In future reports, researchers will further explore the differences in outcomes between these two groups within the ITEST program and the specific activities within ITEST they engage in and make comparisons to URM and non-URM respondents in comparison groups. The current report provides insight into how URM and non-URM students differ in STEM interest and engagement regardless of participation in science education programs.

Motivation to pursue STEM careers (STEM career interest)

Interest in science

Respondents answered four questions on a Likert-scale with ratings from 1=strongly disagree to 5=strongly agree regarding their interest in science, which were averaged by to compute an index by URM status. Example items in the index included "I want to understand science" and "I like to see how things are made." The URM group reported higher average interest (M=4.21, SD=0.64) than the Non-URM group (M=3.79, SD=1.05) and those who did not report their URM status (M=3.97, SD=0.92).

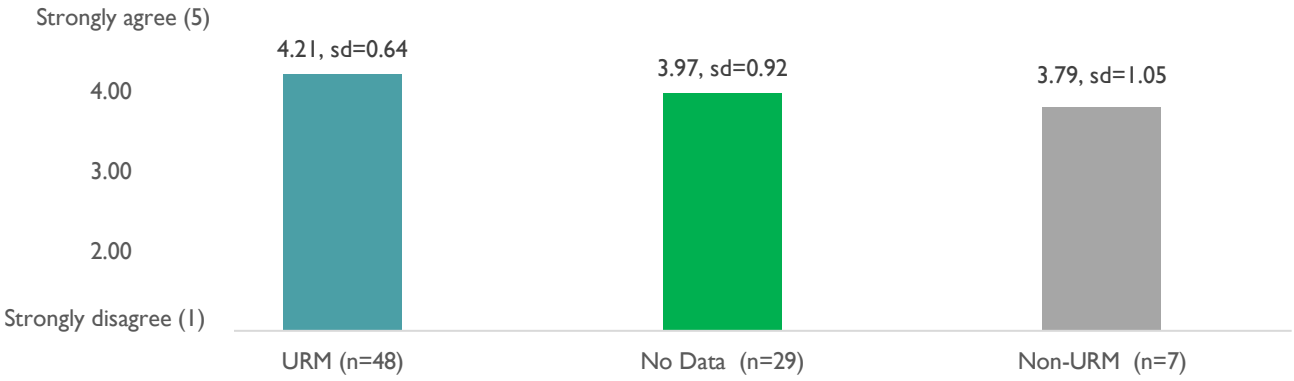


Figure 18. Respondents' average interest in science by URM status

Expectation of success (Expectancy)

Respondents answered two questions on a Likert-scale with ratings from 1=strongly disagree to 5=strongly agree which were averaged to compute an index. These questions included "Science is hard for me compared to most other students" and "I will have a successful professional career and make substantial scientific contributions." The URM group reported lower average expectancy

(M=3.81, SD=0.94) than the Non-URM group (M=3.89, SD=0.74) but higher than those who did not report their URM status (M=3.76, SD=0.95).

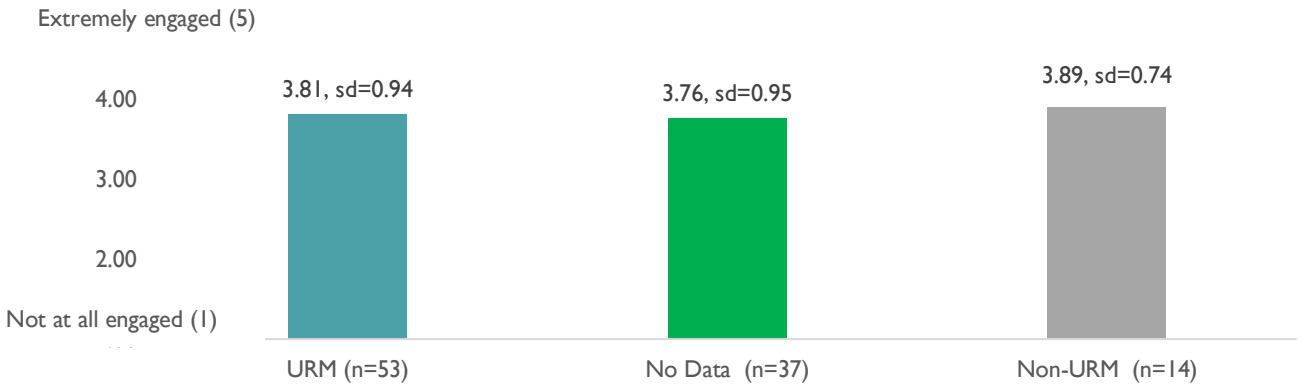


Figure 19. Respondents' average engagement with scientists that contribute to their expectation of success by URM status

Scientific identity (motivation)

Respondents answered two questions on a Likert-scale with ratings from 1=strongly disagree to 5=strongly agree regarding their scientific identity, which were averaged to compute an index. Items in the index included "I have a sense of belonging to a community of scientists" and "I find it personally satisfying to work on a team that is doing research." The URM group reported slightly higher average identity (M=3.65, SD=1.07) than the Non-URM group (M=3.62, SD=1.04) and those who did not report their URM status (M=3.63, SD=0.95).

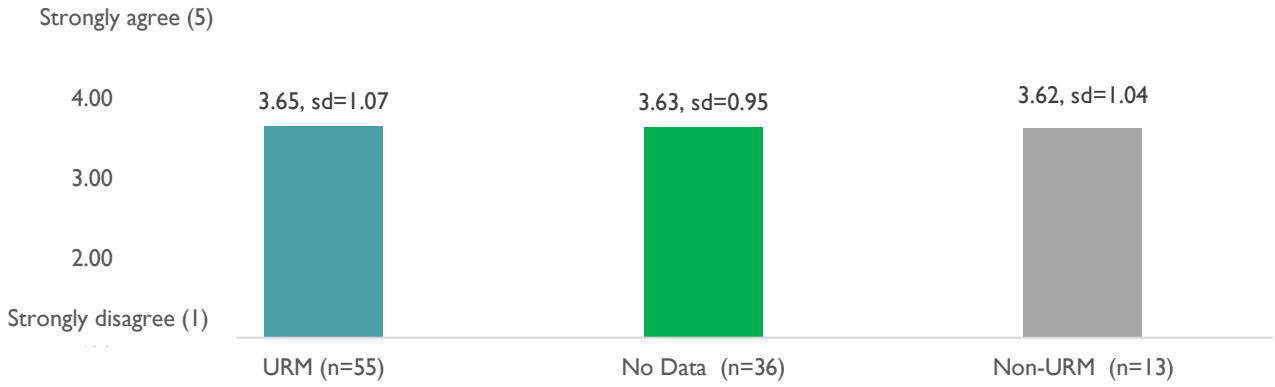


Figure 20. Respondents' average ratings of scientific identity by URM status

Increased awareness of and intent to pursue STEM careers (STEM career interest)

Interest in broad STEM careers

Respondents answered four questions on a Likert-scale with ratings from 1=strongly disagree to 5=strongly agree regarding their broad interest in careers related to STEM fields (science, technology, engineering, and math), which were averaged to compute an index. The URM group reported lower average interest (M=3.38, SD=0.86) than the Non-URM group (M=3.50, SD=1.01) but higher than those who did not report their URM status (M=3.35, SD=0.93).

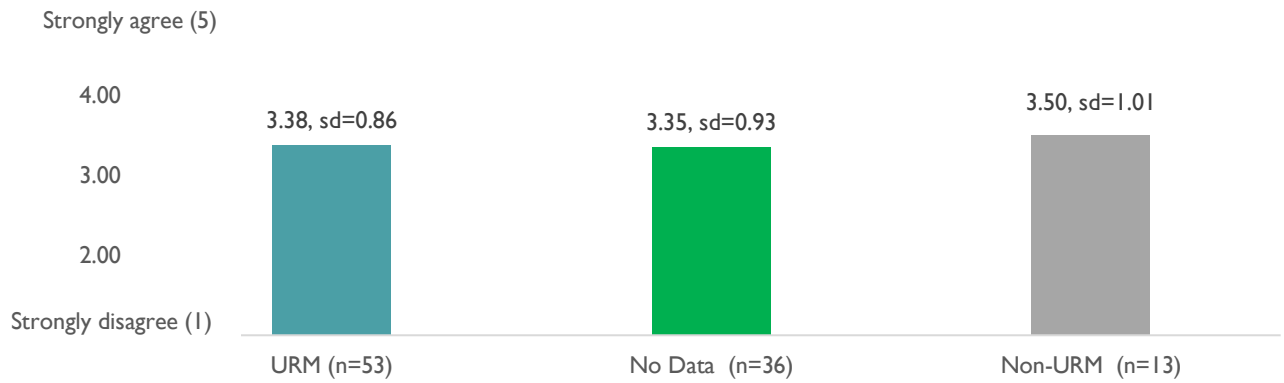


Figure 21. Respondents' average interest in broad STEM careers by URM status

Interest in specific STEM job titles

Respondents answered eight questions on a Likert-scale with ratings from 1=strongly disagree to 5=strongly agree regarding their interest in STEM job titles (e.g. "Hydrologist," "Biological Technician," "Wastewater Engineer"), which were averaged to compute an average index by URM status. Another indicator for the maximum (MAX index) was also calculated and contrasted by URM status. The average index for interest in STEM job titles provides the mean student response regarding their broad interest in different STEM job titles. In contrast, the maximum index for interest in STEM job titles highlights the students' highest interest rating in any of the pre-defined STEM job title options.

Interest in STEM job titles (Avg. index)

Respondents answered questions on their interest in STEM job titles and an average index was computed by URM status. The URM group reported lower average interest (M=2.96, SD=1.08) than the Non-URM group (M=3.10, SD=1.05) group and those who did not report their URM status (M=3.20, SD=1.04).

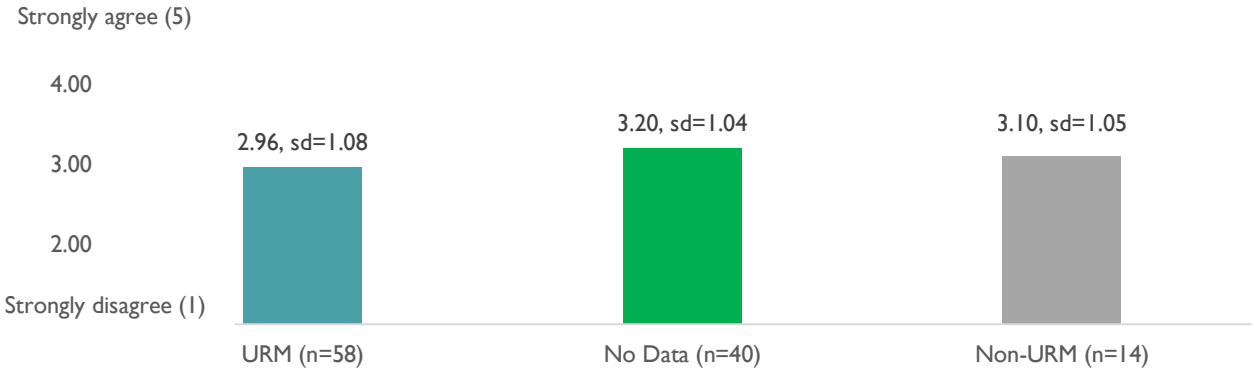


Figure 22. Respondents' average interest in specific job titles by URM status

Interest in STEM job titles (MAX index)

When examining the highest rated STEM job titles among all given options, the URM group reported lower interest ratings (M=3.29, SD=1.08) than the Non-URM group (M=3.65, SD=1.08) and those who did not report their URM status (M=3.40, SD=1.48).

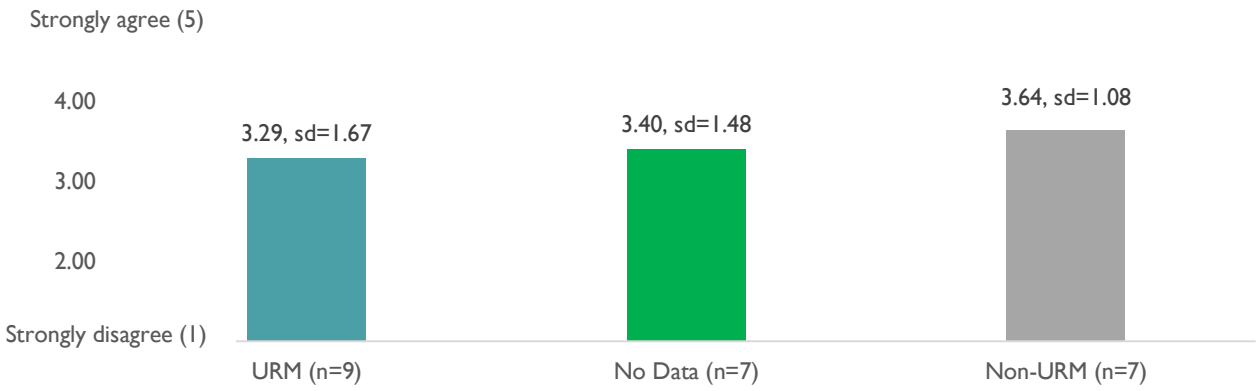


Figure 23. Respondents' average max interest in specific job titles by URM status

Intent to pursue a STEM career

Respondents answered one question, "To what extent do you intend to pursue a [career in science, technology, math, or engineering]?" on a Likert-scale with ratings from 1=definitely will not to 5= definitely will regarding their broad intent to pursue a STEM career. The URM group reported higher average intent (M=3.88, SD=1.16) than both the Non-URM group (M=3.57, SD=1.22) and those who did not report their URM status (M=3.83, SD=1.25).

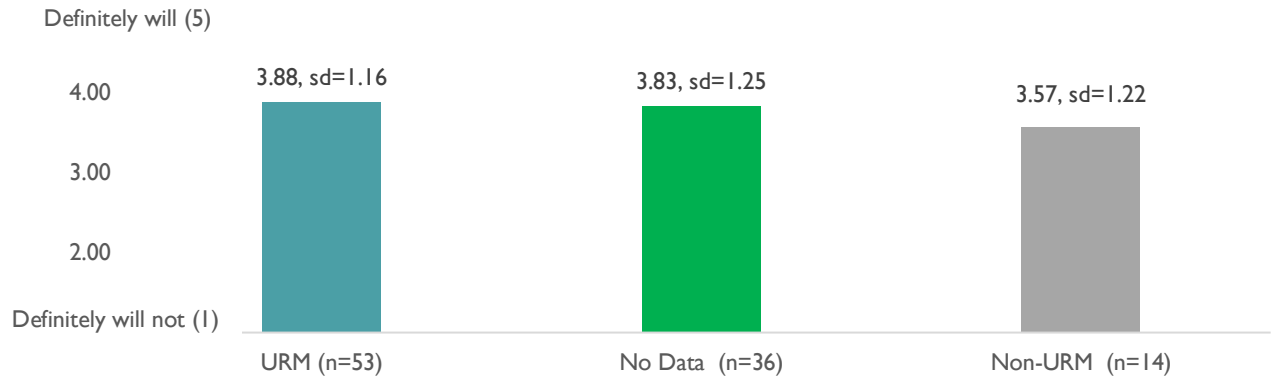


Figure 24. Respondents' average intent to pursue STEM career by URM status

Engagement with scientists (engagement)

General engagement

Respondents answered one question on a Likert-scale with ratings from 1=not at all engaged with scientists to 5=extremely engaged with scientists regarding their general engagement with scientist. The URM group reported higher average engagement (M=3.11, SD=1.29) than both the Non-URM group (M=2.57, SD=1.02) and those who did not report their URM status (M=2.95, SD=1.05).

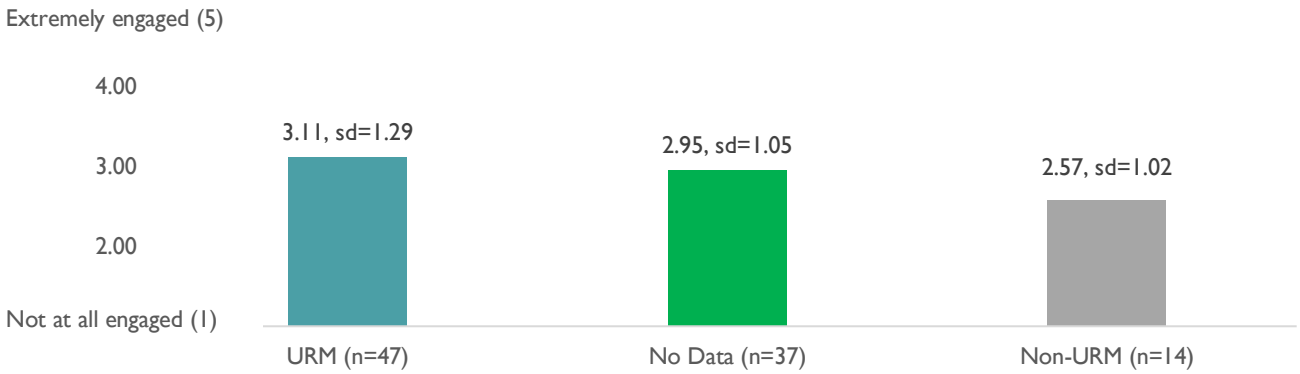


Figure 25. Respondents' average engagement with scientists by URM status

Number of projects students have worked on

Respondents answered questions on whether they worked on direct projects with scientists, the number of directed projects they worked on, and the number of hours they spent on those projects. Overall, a non-URM respondents (29%) engaged in direct projects with scientists compared to the URM respondents (26%) Only two URM respondent shared how many projects (average of 2) and hours spent on the projects (average of 2.5) and one non-URM respondents (5).

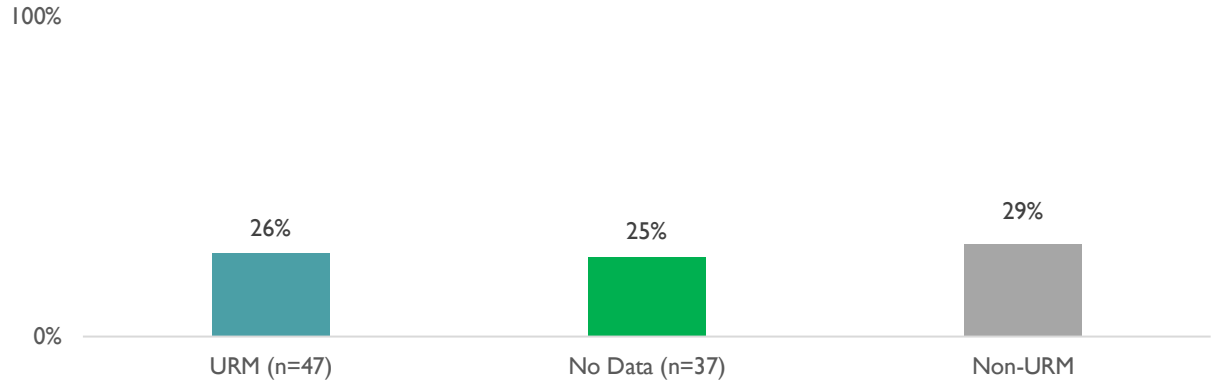


Figure 26. Percentage of respondents who indicated "yes" that they worked on direct projects with scientists by URM status

Number of activities engaged in

Respondents answered questions on the number of 26 possible activities they participated in the past 12 months (e.g., extracurricular activities involving robotics or engineering, volunteered in a science, technology, engineering and/or math field, volunteered in a field related to environmental cleanup and restoration, or participated in any science fairs or tournaments). The URM group reported higher average number of activities (M=1.34) than the Non-URM group (M=1.07) and those who did not report their URM status (M=1.23).

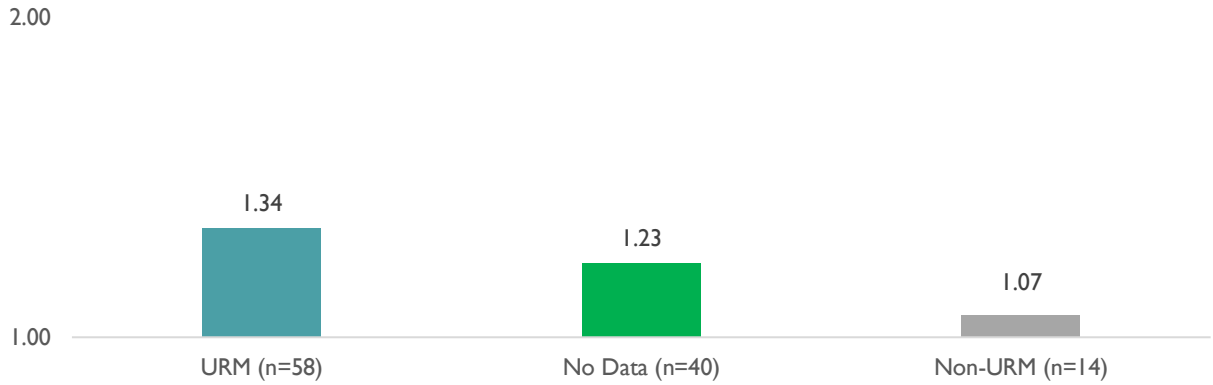


Figure 27. Respondents' average number of activities engaged in by URM status

Engagement with scientists – family or acquaintances

Respondents answered two questions as to whether they have family members or acquaintances who are scientists to compute an average index by group. The URM group reported a lower average number of family or acquaintances (M=0.40) than the Non-URM group (M=1.07) group.

Figure 28. Average engagement with family members or acquaintances who are scientists by URM status

Research question 3: What curricular innovations associated with the CCERS Phase 2 project contribute to heightened awareness of and intent to pursue STEM careers among students? (student learning and engagement)

The research team conducted a document review of the resources and other curricular innovations submitted by CCERS partners to assess their approach to heighten students' awareness of and intent to pursue STEM careers. The research team will use post-survey data after it is collected to assess the impact of dosage in ITEST activities on student outcomes. This section provides an overview of the various activities and resources that BOP partners have adopted to increase the students' awareness and engagement in STEM careers. In addition, BOP staff have also adapted many of their workshops and activities to a virtual platform in response to COVID-19 shelter-in-place guidelines to allow the dissemination of this knowledge to students from the safety of their own home.

BOP CCERS Digital Platform

Among the objectives of creating the BOP CCERS Digital Platform is to provide resources for teachers, students, and community advocates to learn about and participate in the restoration of the New York Harbor. The BOP platform houses research resources and materials for STEM curriculum related to keystone species restoration and can be accessed through this link.

To this date, BOP platform team leads, teachers, and staff have contributed to developing 18 units that include 145 lessons and have taught 1,869 students in New York City Schools. The BOP project enlists the help from 787 team members, 620 leads, 1142 teams and 499 organizations. In addition, to date, the BOP project was successful in launching 555 expeditions, operating 207 oyster restoration stations (ORS), and completing 243 published expeditions.

Access to upcoming events led by BOP staff are listed on the BOP platform through this 'upcoming events' sub-link. Registering for upcoming events may be completed via their Eventbrite website for which a description of the relevant event is summarized, including the expected learning objectives, information on the activity lead(s) and a link to the general research survey bit.ly/bopstudy.

Additional information on the BOP Digital Platform may be accessed through the quick guide link. This introduces the user to how the platform may be used for data analysis and other educational and communication purposes. It is also a resource on how to set up new teams, add team members of teachers and other groups, and create a new expedition. Further detail is also available for team leads to download curriculum lessons and access a library of publications and community feedback. Lessons are searchable by unit, subject area, setting or a keyword. Lesson details on suggested target

audience of grade levels, subject areas, learning objectives, handouts and supply lists required are also shared on this platform.

Through this quick guide, team leads can also sign up for upcoming expeditions and receive detailed information through the Expeditions How To Guide link. Other help topics include a Data How-to Guide to assist users on proper data collection practices including comparing expedition data, downloading results, and preparing them for analysis.

Overview of activities

The following activities have been developed by BOP staff to be used in classroom and field settings. For each of the activities listed, a summarized activity description, the learning objective(s), and other external resources and links are also shared.

1. Activity - STEM Careers in Oyster Restoration – Key Players

More activity information may be accessed here: Rebuild By Design website & SCAPE website

This activity is offered in either a classroom or field setting to 3rd to 5th grade students. The objectives of this activity are to identify different STEM occupations related to an oyster installation structure called The Living Breakwaters; learn how these occupations interact; and identify the top three occupations that are of most interest to the students. The learning steps in this exercise includes: Engage, Explore, Elaborate, Evaluate and Extend.

Students are each handed one 'Key Player card' from the 'Key Players slide deck' in which various occupations are outlined. Students are then allowed time to document any notes and questions they may have related to the card in hand. Then students are divided into four categories/groups in which they are required to: interact with other students with different Key Player cards than the ones they have chosen; discuss how they would be working together; and share the questions/comments they had about their own Key Player card among the group. Students then move to another group to repeat the same activity with other students and engage in similar conversations of how their jobs relate to others, how various groups also interact, and identify other occupations that may also be relevant to the students' occupations.

2. Aquaculture Activity - Oyster Research Tank Guide

This activity is offered in a classroom setting. Learning objectives of this activity include improving skills related to data collection, research, and monitoring. Teachers have the opportunity to adopt an Oyster Research Station (ORS) and can sign up for training via this Eventbrite link. Students are expected to gain field monitoring skills related to the ORS and a baseline point of comparison for the data to be collected.

This activity includes a physical set up of a 5.9-gallon oyster tank in the classroom with various supplies that would enable growing the oysters in the classroom ORS. Teachers are provided a list of

all the supplies and detailed instructions on how to set up their oyster tank, how to care for the living organisms in the tank, and other instructional materials related to ORS monitoring that can be accessed from: Estuarine Aquarium Keeping for Beginners.

3. Marine Biology Activity - Oyster Research Station Guide

The overarching objective for this activity is to provide New York City students and teachers the opportunity to conduct real-world STEM education and research at New York Harbor. This activity first introduces what the Billion Oyster Project (BOP) is about, why the focus on oysters and their role in environmental restoration while providing a competitive educational program and a culture of stewardship. It engages students in the field of environmental science through the 'BOP curriculum' entailing exposure to ORS in the school classrooms and/or field trips to environmental restoration sites. The BOP curriculum is geared to Grades 6-8 but can be adapted for either elementary or high-school level students. Learning objectives of this activity include improving skills related to data collection, research, and monitoring using an Oyster Measurement Data Sheet. Students collect data from their ORS regarding the oyster count of live oysters and their relevant measurements.

4. Marine Systems Technology Activity - What Floats Your Boat?

This activity is offered in a classroom setting to 3rd to 5th grade students. The objectives of this activity are to have students realize physical differences among materials that are denser than water and test their buoyancy, create clay boats that would float in a water tank and discuss the different hull designs and their various purposes in boats. another learning objective is to understand physical properties related to density, buoyancy, structures and center of gravity, water pressure and Archimedes' principle. The learning steps in this exercise includes: Engage, Explore, Elaborate, Evaluate and Extend.

Students are engaged in a demonstration of different clay models of various boat designs. The students are then asked whether they think it would float or sink in water. Their predictions are recorded before the demonstration and then after the demonstration, they record the actual results and compare it to their original predictions and evaluate the lessons learned that are discussed as a group.

5. New York Harbor School - CTE Careers

This activity entails a comprehensive review of the various Career & Technical Education (CTE) tracks offered at the New York Harbor School related to environmental and biological sciences. Details of different career paths, specific job titles and the relevant coursework that correspond to those careers are outlined and shared with the students. These career tracks include: Aquaculture, Marine Biology Research Program, Marine Policy & Environmental Advocacy, Marine Systems Technology, Vessel Operations, Ocean Engineering, and Professional Diving.

6. Ocean Engineering Activity - Design & Engineer a Shell

This activity is offered in a classroom setting to 3rd to 5th grade students. The objectives of this activity include learning how to explore the external and internal anatomy of an oyster using observation, dissection, and two design challenges. Students learn how to dissect an oyster, make inferences on its structure, learn and identify the various body parts of an oyster, and use this information to design an 'oyster predator' that may exist considering the oysters' anatomical structure and morphology. Students engage in learning by touching and observing a live oyster in small groups. Students are expected to document the oysters' structure and information related to its body parts on their data sheets. The student groups are then provided with household items to create a structure to protect the inside of the oyster if it was shucked out of its shell. Students then test out the structures they created by dropping them and are asked to record the results of this drop test. The students then share with other groups explanations of why they chose the materials they chose for their structures and contrast their structures to an oyster shell. The learning steps in this exercise includes: Engage, Explore, Elaborate, Evaluate and Extend.
Additional materials: Oyster Anatomy Slideshow

7. Professional Diving Activity - Buoyancy is the Boss!

The objectives of this activity are to teach students physical properties related to buoyancy, predictions of whether objects would float or sink, and how to plan and conduct a scientific investigation by testing a hypothesis. Students engage in a group activity of constructing a 'neutrally buoyant' scuba diver and then adding different materials to this figure while trying to maintain its neutral buoyancy and recording the type of materials added and the effect(s) it had on the scuba diver figures. The learning steps in this exercise includes: Engage, Explore, Elaborate, Evaluate and Extend.

8. Vessel Operations Activity - A Compass is Key!

This activity is offered in either a classroom or field setting to 3rd to 5th grade students. The objectives of this activity include learning how a compass works, identifying the compass directions, how to use a compass by taking a bearing and the direction of bearing. Students engage in this group activity to build their own compass and test it by pointing to various objects in their vicinity and recording their observations. The learning steps in this exercise includes: Engage, Explore, Elaborate, Evaluate and Extend.

Other curricular innovations

BOP staff met with the New York Harbor School (a public high school) freshmen over zoom on Wednesday, Oct 21st and Friday, Oct 23rd, 2020 to give them an introduction to BOP and the work they do for ITEST Pillar 4. These sessions were the first of a series of presentations. The second round of presentations by BOP staff were conducted on January 11th and 13th, 2021.

These presentations are considered a curricular innovation to disseminate the information about Advanced Research Methods to teachers and students by the end of the 2020-2021 school year.

Further presentations will be scheduled throughout the spring semester, including a virtual visit from Pillar 4 scientists and an introduction to the procedures and activities of the different labs. In year 2, the labs submitted lab protocols and classroom activities. These materials were published on the digital platform and were made available for teachers. Widely distributing these materials that can be used in a virtual classroom setting allow students to have access to protocols and processes used in professional science labs thereby heightening their awareness of (and in turn desire to pursue) STEM careers.

Other innovations were also adapted for each of the other pillars. For Pillar 1 STEM HUBS, BOP staff added a series of sequenced classroom (or virtual) visits throughout the school year (and bookended by visits to the actual STEM Hubs) to further engage students in the work and science at the STEM Hubs.

BOP staff added the 'Near Peer Career panels' for Pillar 2 to address the remote environment of all NYC middle school students. These panels connect middle school students with current Harbor School students and industry professionals so that they have a heightened awareness of STEM careers. The recordings of the webinar panels can be accessed online.

Finally, BOP staff compiled a set of visually pleasing resources for Pillar 3 specifically about the marine and maritime CTE programs at the Harbor School to accompany the classroom activities. These resources highlight not only the CTE programs, but also the careers to which they lead. These resources immerse the students into the program and introduce the various STEM career paths while providing additional online resources that all students can also access.

Summary of findings

Research question	Summary of findings
Research Question 1: How does the CCERS Phase 2 project influence motivation and preparation to pursue STEM careers among K-12 students?	Analysis results indicate that ITEST respondents on average have higher levels of motivation, interest, and engagement than general low-engagement comparison group, which is expected given they are provided more opportunities to learn about STEM through participating in STEM activities, engaging with scientists, and getting guidance from mentors than the comparison group students. In comparison to higher engagement groups, ITEST respondents had a higher self-rating on scientific identity, intent to pursue STEM careers, and engagement in STEM activities than the NY Aquarium respondents, but lower than STEM+C respondents. This suggests that ITEST is reaching students who have high motivation and interest in STEM. This also demonstrates the fact that immersing students with more activities aligned with their predefined higher motivation could potentially lead to further student engagement and learning development.
Research Question 2: What aspects of the CCERS Phase 2 project have a positive influence on underrepresented students' motivation and preparation to pursue STEM careers, compared to other students?	URM respondents in general had higher levels of interest in STEM and scientific identity than non-URM respondents. However, they had a lower expectation of success in STEM and interest in STEM careers, indicating that URM respondents may need more support to feel confident and become aware of opportunities for them in STEM. They also had engaged in a higher number of activities compared to non-URM respondents, but in shorter amount of time. Participating in ITEST activities may help to close this gap and the research team will use post-surveys to explore this more. These findings speak to the potential influence the project may have on positively influencing URM students' motivation and preparation to pursue STEM careers relative to other students. The research team will further monitor any changes in the items related to student's self-efficacy and confidence relevant to the students' engagement and findings in post survey results, which will be shared in follow up reports.
Research Question 3: What curricular innovations associated with the CCERS Phase 2 project contribute to heightened awareness of and intent to pursue STEM careers among students?	A document review was completed of the various resources, classroom and field activities, the BOP Digital Platform and other resources adapted for online learning. A review of the curricular innovations indicates that the activities that were designed and are being implemented provide opportunities to engage students in STEM, build their knowledge and skills in marine sciences, and thus help to enhance their interest in STEM.

Overall summary: In year 3, the research team has worked with BOP staff and partners to collect data on students' motivation and intent to pursue STEM careers, reaching over 500 students through a general link and collecting 111 responses with matched parental consent. Findings showed that on average, the ITEST project is reaching students who have high levels of interest and motivation to pursue STEM. Additionally, given that URM respondents had a lower expectation of success and interest in pursuing STEM careers, this provides an opportunity for the ITEST project to enhance URM students' motivation to pursue STEM careers. The curricula and innovations designed by the ITEST project demonstrate that the project will provide more opportunities for students to learn about STEM through participating in STEM activities, engaging with scientists and getting guidance from mentors, which can help URM students and further enhance participants' motivation in STEM. However, results should be interpreted with caution as the sample size in the treatment group is small and analysis did not yet integrate pre- and post-comparisons.

The following accomplishments and milestones for the CCERS project pertain to Research Questions 1 and 2 and have been noted to improve **student engagement**, **student learning** and the students' **interest in STEM careers** and are identified for each of the four project pillars.

Pillar 1: Community Based Restoration Stem Hubs

***Pillar 1 Strategic Priority*:** STEM Hubs are active scientific restoration sites capable of hosting school and community groups of all grade levels and professional scientists and researchers conducting long-term restoration ecology research.

Pillar 1 Strategic Objective: Create a physical space and intellectual community for direct collaboration between students, educators, scientists and industry professionals.

Pillar 1 Strategic Milestones

1. STEM Hub outreach and engagement with local schools and community groups
2. Selection of participating school/community groups for each STEM Hub
3. Recruitment and selection of STEM Hub Site Scientists.
4. Development of digital platform to include STEM Hub data
5. STEM Hub classroom workshops planned, researched, written, and published (Digital Platform)
6. CIC group 1 & 2 Monitoring sessions & data upload
7. Encouragement and assistance with student research projects
8. Student participation in the annual BOP research symposium

Pillar 2: Near Peer Mentoring Program

Pillar 2 Strategic Priority: Provide a support network to motivate and guide students toward restoration science-based Career and Technical Education (CTE) pathways.

Pillar 2 Strategic Objective: Support new student development/strengthen skills to succeed in CTE program.

Pillar 2 Strategic Milestones

1. Research mentoring programs and develop curriculum for two cohorts.
2. Recruit new students; recruit and train mentoring students
3. Plan and execute mentorship program kick-off event
4. Plan and execute monthly meetings & quarterly field trips
5. Mentors and mentees prepare and present at BOP symposium.

Pillar 3: Restoration Science Professional Development for Elementary Teachers

Pillar 3 Strategic Priority Create a multi-part professional learning series for NYC public school elementary teachers related to the Career and Technical Education (CTE) programs of New York Harbor School.

Pillar 3 Strategic Objective: Provide teachers with curriculum/instructional support that incorporates STEM.

Pillar 3 Strategic Milestones

1. Survey current elementary teachers regarding interest in CTE
2. Research and write curriculum for each CTE PD
3. Outreach and recruit elementary school teachers
4. Implement CTE related PDs
5. Conduct classroom visits to teachers utilizing CTE PDs
6. Review final edits and upload curriculum onto digital platform

Pillar 4: Advanced Methods in Restoration Science for High School Teachers

Pillar 4 Strategic Priority: Expand the capacity to critically engage high school students in advanced elements of scientific restoration and environmental monitoring with direct STEM industry professionals.

Pillar 4 Strategic Objective: Provide teachers with trainings in one or more of the following areas: genetic barcoding, bacterial monitoring, DNA sampling, water chemistry, and microplastics in order to provide standardized protocols.

Pillar 4 Strategic Milestones

1. Recruit, research, and plan advanced protocols for teachers and students
2. Implement training and collect data on genetics, bacterial monitoring, DNA sampling, water chemistry, and microplastics
3. Presentations at annual BOP symposium

Project Deliverables

Pillar 1: Community Based Restoration Stem Hubs Deliverables

STEM Hub Classroom Guide, Site Scientist Report, BOP NYC STEM Hub Development Report, BOP CCERS Digital Monitoring Platform.

Pillar 2: Near Peer Mentoring Program Deliverables

Mentoring Guide Summary of Activities, Events, Meetings and Resources for Mentee Support, Mentoring Program Assessment, STEM Career Guide; Information Guide.

Pillar 3: Restoration Science Professional Development for Elementary Teachers Deliverables

CTE Classroom Activities; Curriculum for Elementary Teachers, CTE Course Descriptions Catalog, STEM Teacher Training Model, Remote/Online Learning Activities.

Pillar 4: Advanced Methods in Restoration Science for High School Teachers Deliverables

Laboratory Methods Classroom Activities Manual; Each Laboratory (Hybrid Model Online, Field, Real Time Trainings).

Additional Items will also be attained throughout the length of the project:

- BOP CCERS Phase II Project White Paper
- Journal Publications and Scholarly Research Articles
- Annual BOP Symposium
- Summer STEM Institute at Pace University
- Presentations, Symposia, Forums and Related Colloquia
- Public Interest Videos and Film
- Restoration Based Science Model

To further demonstrate the overall impact relevant to Research Question #3 on intellectual merit, community outreach and curricula innovations, project staff shared a table of the BOP STEM learning YouTube video events for workshops held between the dates from February 2020 until November 2020. The workshops can be accessed from BOP's remote learning website at: BOP Remote Learning Website: https://www.billionoysterproject.org/remote-learning. This remote learning website was launched on March 31, 2020 targeted for teachers, students and families as a means to support and mitigate the learning challenges due to COVID-19 restrictions. As of the end of 2020, the page has been viewed 24,670 times by various users.

The table below provides a detail on the events that are included in the BOP Remote Learning Website outlining the workshop titles, dates of the workshops and the total number of views by workshop attendees.

BOP STEM Learning YouTube Video Views

Title	Date	Number of views
Lobster Shell Collection for the Billion Oyster Project	February 14th, 2020	409
Comb Jelly under Billion Oyster Project's Eco Dock	March 3rd, 2020	84
How to Make a DIY Hydrometer	March 27th, 2020	19,234
Oyster Larvae in the Harbor School Hatchery	March 31st, 2020	51
Gabion Construction at Billion Oyster Project	April 1st, 2020	66
Butterfly fish at Pier 101	April 1st, 2020	58
Make your Own Oyster Research Station (ORS)	April 3rd, 2020	207
How the Billion Oyster Project Got Started	April 4th, 2020	135
Oyster Anatomy	April 5th, 2020	1,019
Imagine No CSOs	April 10th, 2020	242
How to Build a Paper Oyster Dory	April 11th, 2020	241
Do-it-yourself Anemometer	April 13th, 2020	134
Fishy Friday: Striped Bass	April 16th, 2020	40
Billion Oyster Project Hatchery: Q&A	April 16th, 2020	76
Monitoring a BOP Oyster Research Station	April 17th, 2020	269
Billion Oyster Project Design & Engineering Challenge	April 20th, 2020	80
Create a Fish out of Salt Dough!	April 22nd, 2020	231
Earth Day Chat with pete Malinowski and Murray Fisher	April 23rd, 2020	80
Coney Island Creek	April 25th, 2020	301
Billion Oyster Project: Down To The Sea	May 1st, 2020	192
Bushwick Inlet	May 1st, 2020	201
Oyster Research Station Checkup	May 14th, 2020	122
Mummichogs in Queens	May 15th, 2020	223
Billion Oyster Project Panel: Minorities in STEM	June 19th, 2020	104
Welcome to the New York Harbor SEALs	June 30th, 2020	104
Soundview Shell Dump	July 10th, 2020	238
Billion Oyster Project	July 22nd, 2020	56
Soundview Gabion Deployment	July 27th, 2020	214
Lemon Creek Lagoon Monitoring	July 29th, 2020	59
Canarsie Oyster Monitoring	July 29th, 2020	32
Bayswater Installation	July 29th, 2020	60
Happy National Oyster Day from Coney Island	August 5th, 2020	44
Billion Oyster Project's Water Quality Protocol	October 22nd, 2020	29
Billion Oyster Project: Creepy Critters (recording of live event)	October 30th, 2020	31
Near Peer Panel Series: Vessel Operations (recording of live event)	November 12th, 2020	4

Next steps in research

In Years 4 and 5, researchers will modify the data collection strategy to capture a larger number of ITEST participants' responses. In Spring 2021 researchers will also administer post-surveys to students who have provided parental consents. Post-survey analysis will explore the differences in career awareness and interest by activity to identify the extent to which the activities had an impact on students and examine the outcomes among URM students in ITEST and the three comparison groups. Researchers will work with partners to continue to identify events to reach students. Since a challenge in collecting research data has been the difficulty in obtaining parental consent, researchers will also discuss strategies with partners to engage parents and students to provide consent to complete the surveys. This will include discussions of strategies for ways to collect parental consent of students who have already completed the evaluation portion of the survey, which did not require parental consent.

Appendix A. ITEST motivation & intent to pursue STEM careers instrument deliverable 1.4

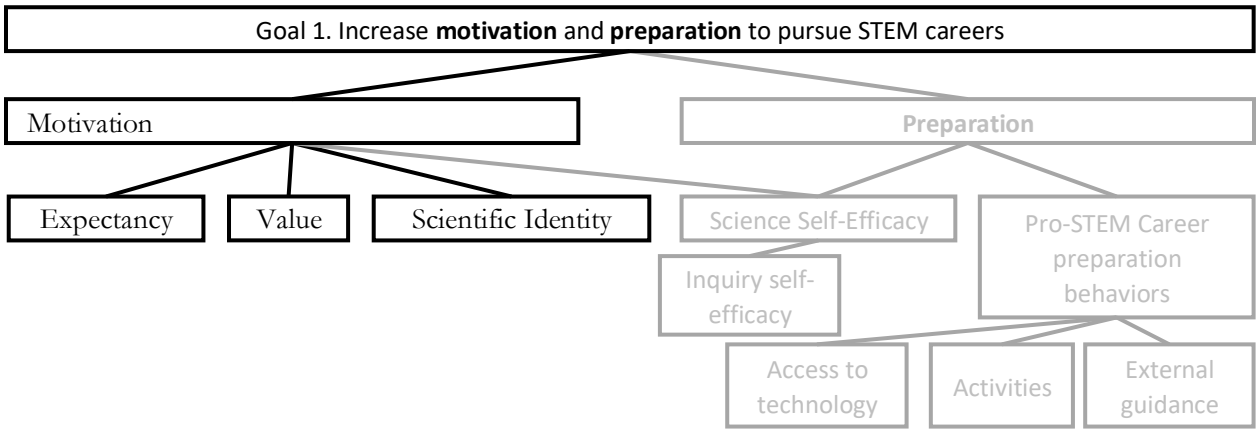
Motivation & Intent to Pursue STEM Careers CCERS ITEST Instrument 2019-03-04

Introduction:

The purpose of this deliverable is to thoroughly document the instruments developed for this project for the benefit of the research team, project partners and future researchers. It has three objectives:

a) Identify the construct(s) each question measures,
b) Present the rationale behind the choice of measures,
c) Present how the items work in context of the overall project logic model.

This inventory contains questions related to the program goal 1 "**increase motivation and preparation to pursue STEM careers.**"



Constructs

- **Expectation of success (Expectancy)**: A person's beliefs about their ability in a particular subject. Students are motivated to achieve when they expect to succeed, according to Eccles' and Wigfield's expectancy-value theory (as cited in Robnett & Leaper, 2013).
- **Subjective Task Value (Value)**: How much a person enjoys a particular subject, perceives its utility for future goals, and rates the relative importance of a goal over others. Students are motivated to achieve when they value the subject they are working in, according to Eccles' and Wigfield's expectancy-value theory (as cited in Robnett & Leaper, 2013).
- **Scientific Identity**: How much a person identifies as a scientist and feels a sense of belonging to the scientific community. Estrada et al. (2011) cited seven studies published between 1995 and 2007 that found scientific identity to be particularly important for minority students. They hypothesized that a student who assumes the identity of a scientist

will be more likely to pursue a career in the sciences, and their results provided positive evidence for this hypothesis.

- **Intent to pursue a STEM career**: Estrada et al. (2011) called this construct "scientific integration" and measured it with a single item: "intent to pursue a science-related research career" on a ten-point scale. The scientific identity items included in this inventory were significantly correlated with intent to pursue a STEM career (.43 to .46)

Rationale and history of instrument development

The research team conducted a review of the literature pertaining to motivation towards STEM careers. Six of 20 articles reviewed contained questions that the team considered for inclusion. Out of these six articles, we selected items from two sources: Robnett & Leaper (2013) and Estrada et al. (2011).

- Robnett & Leaper (2013) included items to measure expectancy and task value. These items had high face validity for the research team based on their experience with CCERS Phase 1 (2014 to 2018). The use of the expectancy-value model of achievement also provides continuity from items in CCERS Phase 1, as it was used to categorize variables in the analysis phase of research.
- Estrada et al. (2011) included items to measure value orientation, scientific self-efficacy, and scientific identity. Of these, scientific identity consistently had the highest correlations with intent to pursue a science related research career (0.43 for undergraduates). The value orientation construct they used is more aptly described as a subconstruct of scientific identity. It relies on questions about how much participants identified with a series of descriptions and is not compatible with the value construct in the expectancy-value model of achievement.

The use of Estrada et al's scientific identity and intent to pursue a scientific career items provide an opportunity to publish an article that reproduces their basic design and expands it to two new areas: i) middle school and high school students (their article covered undergraduates) and ii) constructs from the expectancy-value model of achievement.

See Appendix B for context on where expectation and value fit within Eccles & Wigfield et al.'s expectancy-value model of achievement motivation.

Distribution

This inventory will be inserted into surveys that will be sent to student participants who were involved in the STEM Hubs, near-peer mentoring, or advanced methods training activities, as well as to comparison students who did not participate in those activities.

Survey Questions

We classify each question using the following categories:

- **Expectancy**: Questions related to a person's expectation of success in science. To measure expectancy, we use two out of seven items used by Robnett and Leaper (2013). Their original seven-item scale had a Cronbach's alpha (α) of 0.85.
- **Value**: Questions related to a person's subjective value of science learning and related tasks in school. To measure value we use two out of six items used by Robnett and Leaper. Their original six-item scale also had a Cronbach's alpha (α) of 0.85.
    - **Intrinsic value is** "the enjoyment one gains from doing the task" (Wigfield & Eccles, 2000)
    - **Utility value** is "how a task fits into an individual's future plans … doing a task not for its own sake but ot rech some desired end state (Wigfield & Eccles, 2000)
- **Scientific Identity**: Questions related to a sense of belonging in science. We use two out of five items used by Estrada et al. (2011). Their original five-item scale had a Cronbach's alpha (α) of 0.87.

Motivation to pursue STEM careers

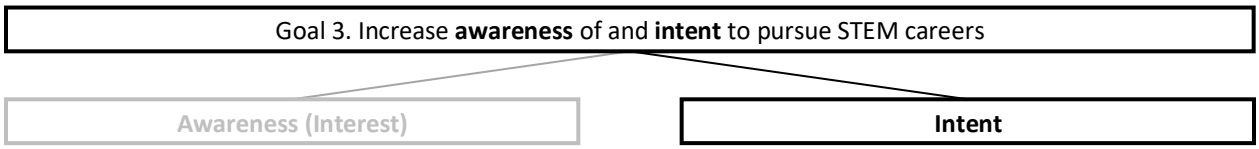
Changes from the original question text to improve respondent comprehension are marked in red text. These changes were suggested by Gaylen Moore based on her evaluation experience working with students in this age range.

Question	Original Scale	Modified scale	Category and notes	Source
Compared to most other students in your classes, how hard is science for you?	1 = Much harder, 2, 3, 4 = Much easier	1 = Much harder, 2, 3, 4, 5 – Much easier	Motivation to pursue STEM careers. **Expectancy**	(Robnett & Leaper, 2013)
How much effort would you need to do well in an advanced science course?	1 = A lot to, 2, 3, 4 = Almost none	1 = A lot, 2, 3, 4, 5 = Almost none	Motivation to pursue STEM careers. **Expectancy**	
In general, how interesting or fun do you find working on assignments in science class	1 = Very boring, 2, 3, 4 = Very interesting	1 = Very boring 2, 3, 4, 5 = Very interesting	Motivation to pursue STEM careers. **Value (Intrinsic)**	
Compared to most of your other activities, how useful is your learning in science class?	1 = Least useful, 2, 3, 4 = Most useful	1 = Least useful 2, 3, 4, 5 = Most useful	Motivation to pursue STEM careers. **Value (Utility)**	(Robnett & Leaper, 2013)
I have a sense of belonging to a community of scientists	1 (strongly disagree), 2, 3, 4 5 (strongly agree)	*No changes*	Motivation to pursue STEM careers. **Scientific Identity**	(Estrada, Woodcock, Hernandez, & Schultz, 2011)
I find it personally satisfying to work on a team that is doing important research	1 (strongly disagree) 2, 3, 4, 5 (strongly agree)	*No changes*	Motivation to pursue STEM careers. **Scientific Identity**	
What I learn in science is important to me because I need this for what I want to study later on	Strongly Disagree, Disagree, Maybe, Agree, Strongly Agree	*No changes*	Motivation to pursue STEM careers. Interest in science. Value. Utility	Gaylen Moore & The Mark (CCERS Phase II Teacher and Student Surveys)

I enjoy learning new things in science	Strongly Disagree, Disagree, Maybe, Agree, Strongly Agree	*No changes*	Motivation to pursue STEM careers. Interest in science. Value. Intrinsic	Gaylen Moore & The Mark (CCERS Phase II Teacher and Student Surveys)
I like to participate in science projects	Strongly Disagree, Disagree, Maybe, Agree, Strongly Agree	*No changes*	Motivation to pursue STEM careers. Interest in science. Value. Intrinsic	Gaylen Moore & The Mark (CCERS Phase II Teacher and Student Surveys)
Studying science is worthwhile for me because what I learn will improve my career opportunities	Strongly Disagree, Disagree, Maybe, Agree, Strongly Agree	*No changes*	Motivation to pursue STEM careers. Interest in science. Value. Utility	Gaylen Moore & The Mark (CCERS Phase II Teacher and Student Surveys)
I am interested in learning about science	Strongly Disagree, Disagree, Maybe, Agree, Strongly Agree	*No changes*	Motivation to pursue STEM careers	Gaylen Moore & The Mark (CCERS Phase II Teacher and Student Surveys)
I would like to have a career in science	Strongly Disagree, Disagree, Maybe, Agree, Strongly Agree	*No changes*	Interest in science career	Gaylen Moore & The Mark (CCERS Phase II Teacher and Student Surveys)
My family has encouraged me to study science	Strongly Disagree, Disagree, Maybe, Agree, Strongly Agree	*No changes*	Motivation to pursue STEM careers	Gaylen Moore & The Mark (CCERS Phase II Teacher and Student Surveys)
I will get into college and take courses needed for a career in science	Strongly Disagree, Disagree, Maybe, Agree, Strongly Agree	*No changes*	Motivation to pursue STEM careers. Expectancy	Gaylen Moore & The Mark (CCERS Phase II Teacher and Student Surveys)
I will graduate with a college degree that I need to have for a career in science	Strongly Disagree, Disagree, Maybe, Agree, Strongly Agree	*No changes*	Motivation to pursue STEM careers. Expectancy	Gaylen Moore & The Mark (CCERS Phase II Teacher and Student Surveys)
I will have a successful professional career and make substantial scientific contributions	Strongly Disagree, Disagree, Maybe, Agree, Strongly Agree	*No changes*	Motivation to pursue STEM careers. Expectancy	Gaylen Moore & The Mark (CCERS Phase II Teacher and Student Surveys)
Some day when I tell others about my career, they will respect me for doing scientific work	Strongly Disagree, Disagree, Maybe, Agree, Strongly Agree	*No changes*	Motivation to pursue STEM careers. Value. Utility	Gaylen Moore & The Mark (CCERS Phase II Teacher and Student Surveys)
A career in science would enable me to work with others in meaningful ways.	Strongly Disagree, Disagree, Maybe, Agree, Strongly Agree	*No changes*	Motivation to pursue STEM careers. Value. Utility	

Intent to pursue a STEM career

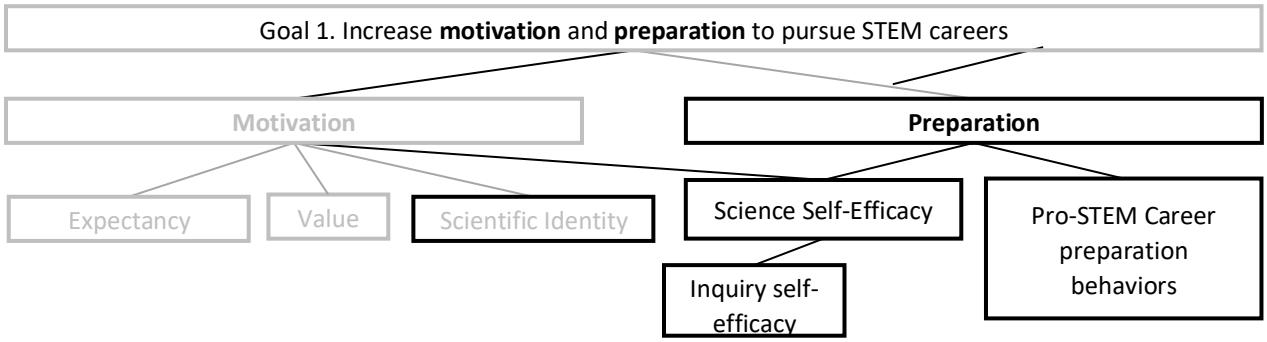
- **Intent to pursue a STEM career**: This item was adapted from Estrada et al. They defined scientific integration as "intent to pursue a science-related research career."



Question	Scale	Modified scale	Category and notes	Source
To what extent do you intend to pursue a [career in science, technology, math, or engineering]? [3]	0 (definitely will not) to 10 (definitely will).	*No changes*	Intent to pursue a STEM career	(Estrada, Woodcock, Hernandez, & Schultz, 2011)

Preparation for STEM Careers Compiled 2021-01-15

Introduction:



Science self-efficacy items

Question	Scale	Category and *notes*	Source
I can make good observations during a science activity.	Strongly Disagree, Disagree, Maybe, Agree, Strongly Agree	Science self efficacy. Inquiry self efficacy	Gaylen Moore & The Mark (CCERS Phase II Teacher and Student Surveys)
I can ask good questions about what is happening during a science activity.	Strongly Disagree, Disagree, Maybe, Agree, Strongly Agree	Science self efficacy. Inquiry self efficacy	Gaylen Moore & The Mark (CCERS Phase II Teacher and Student Surveys)

[3] Original wording was "science related research career?"

Question	Scale	Category and *notes*	Source
I can design an experiment that will answer a question about a science activity or topic	Strongly Disagree, Disagree, Maybe, Agree, Strongly Agree	Preparation to pursue STEM Careers. Science self-efficacy	Gaylen Moore & The Mark (CCERS Phase II Teacher and Student Surveys)
I can take measurements and collect data accurately during a science activity	Strongly Disagree, Disagree, Maybe, Agree, Strongly Agree	Preparation to pursue STEM Careers. Science self-efficacy	Gaylen Moore & The Mark (CCERS Phase II Teacher and Student Surveys)
I feel confident about my ability to explain how to do scientific activities to others	Strongly Disagree, Disagree, Maybe, Agree, Strongly Agree	Preparation to pursue STEM Careers. Science self-efficacy	Gaylen Moore & The Mark (CCERS Phase II Teacher and Student Surveys)
I think I could be a good scientist	Strongly Disagree, Disagree, Maybe, Agree, Strongly Agree	Preparation to pursue STEM Careers. Science self-efficacy	Gaylen Moore & The Mark (CCERS Phase II Teacher and Student Surveys)

Bibliography

Estrada, M., Woodcock, A., Hernandez, P. R., & Schultz, P. W. (2011). Toward a model of social influence that explains minority student integration into the scientific community. *Journal of Educational Psychology*, *103*(1), 206.

Robnett, R. D., & Leaper, C. (2013). Friendship Groups, Personal Motivation, and Gender in Relation to High School Students' STEM Career Interest. *Journal of Research on Adolescence*, *23*(4), 652–664. https://doi.org/10.1111/jora.12013

Wigfield, A., & Eccles, J. S. (2000). Expectancy–Value Theory of Achievement Motivation. *Contemporary Educational Psychology*, *25*(1), 68–81. https://doi.org/10.1006/ceps.1999.1015

Awareness of STEM Careers CCERS ITEST Instrument: 2019-03-05

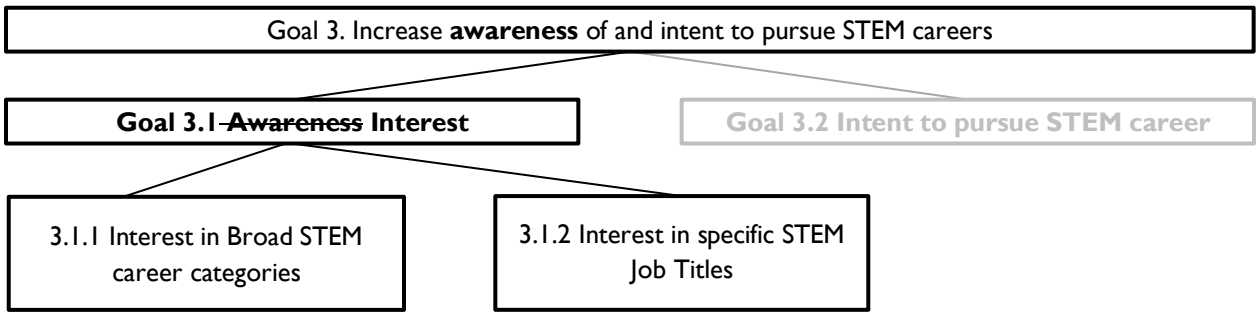
Updated 2021-01-19 by Joshua Yuen Penman

Introduction:

The purpose of this deliverable is to thoroughly document the instruments developed for the CCERS project for the benefit of the research team, project partners, and future researchers. It has three objectives:

a) Identify the construct(s) each question measures,
b) Present the rationale behind the choice of measures,
c) Present how the items work in context of the overall project logic model.

This inventory contains questions related to the program Research Question 3 "What curricular innovations associated with CCERS Phase 2 contribute to **heightened awareness of** and intent to pursue STEM careers among CCERS students?" The rationale section below explains how and why we re-operationalized "awareness" of STEM careers to "interest" in STEM careers for this instrument.



Constructs

- **3.1 Interest in STEM careers**: measured by a student's rating of a semantic differential on how appealing careers in STEM are (Tyler-Wood et al., 2010).
    - **3.1.1 Broad STEM categories:** Items that measure career interest in broad areas of science, technology, engineering and mathematics.
    - **3.1.2 Specific STEM job titles:** Items that measure interest in specific job titles from three of seven career tracks offered by the New York Harbor School CTE program.[4] These career tracks (aquaculture, marine systems technology, and marine biology research) were chosen because they best fit CCERS activities measuring oyster sizes and water quality.

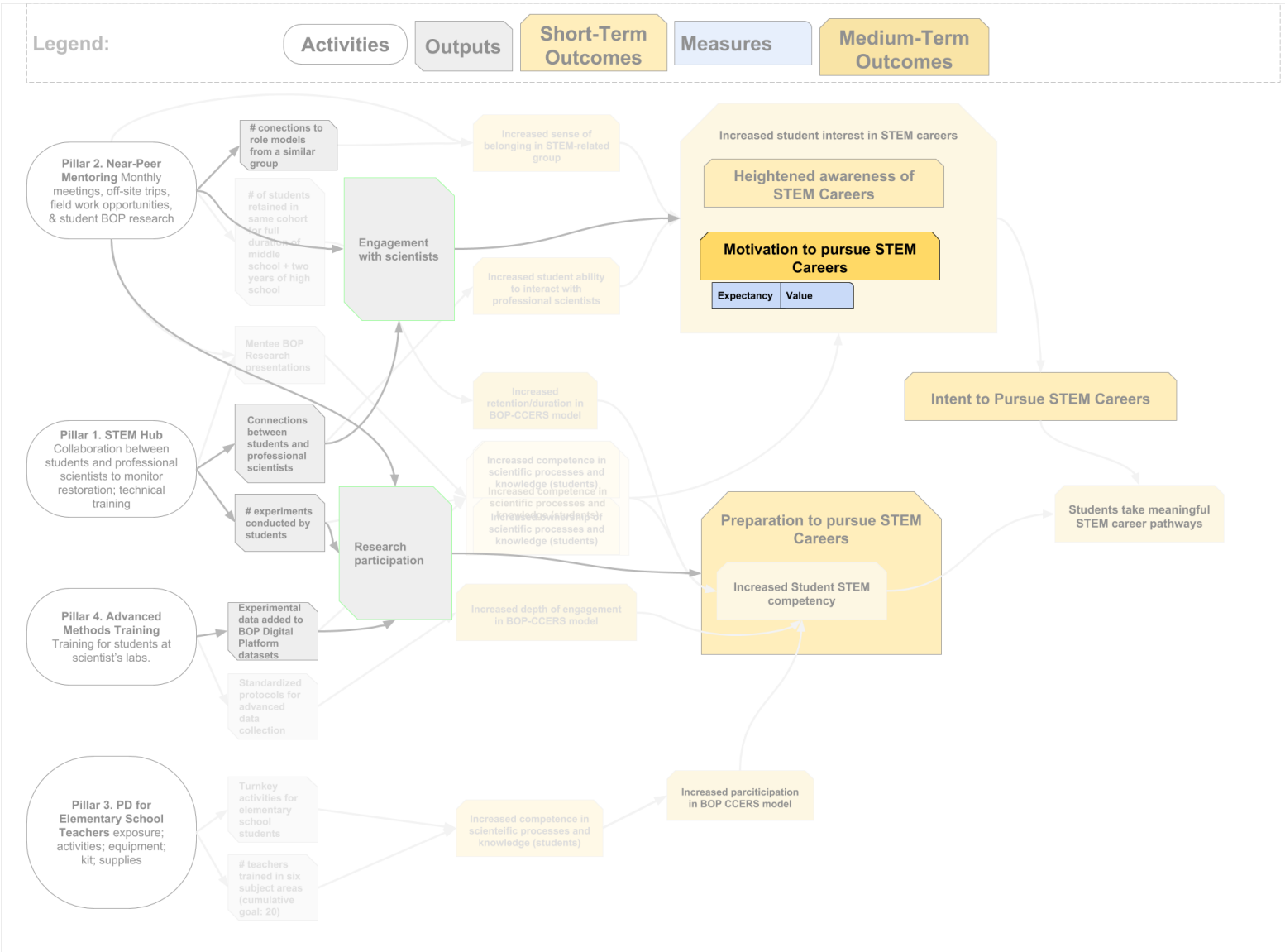
[4] https://www.newyorkharborschool.org/cte_programs.html

Rationale and history of instrument development

The research team searched for instruments to measure awareness of STEM career options but was unable to find any that directly related to students' awareness of STEM careers. However, we did find appropriate items related to student interest in STEM careers, and this fits into our logic model as well as awareness. A synopsis of our search is provided for each construct below.

Definition of STEM careers: careers in "the science, engineering, technology and mathematics workforce". In the current report, we focus specifically on the sub-baccalaureate technical STEM careers, which require high school or two-year technical training or certification as well as a noteworthy amount of STEM knowledge on the job (National Science Board. 2015).

Motivation instrument in context of CCERS ITEST Logic Model **V.1.2.1 February 28, 2019]**



Awareness of STEM careers: One out of four articles found on high school and undergraduate students' career-related constructs had a direct measure for STEM career awareness: "the [project activity] has made me aware of STEM career opportunities" (Russomanno et al., 2010). The other three articles did not include individual items. Instead, they measured dosage of activities expected to lead to general career awareness not specific to STEM careers (Kemple, Poglinco, & Snipes, 1999) or utilization of available resources for general career development (Fouad et al., 2006). The final article measured interest and attitudes in STEM subjects and career as well as the changes in these perceptions with a semantic differential scale (Tyler-Wood et al., 2010, p.). See **Error! R eference source not found.** for the research team's annotated version of these items.

Interest in STEM careers: The interest items in literature tended to ask directly about interest in science, technology, engineering, and math. The research team felt that these broad categories were insufficient for measurement of interest in STEM careers. See We expect participants in CCERS target age groups to respond better to more specific examples rather than general examples when expressing interest (see Richardson, 2003 for an example from cognitive psychology comparing concrete examples to abstract examples). Therefore, the research team reached out to the program activity coordinators to generate a list of specific job titles within various STEM careers that participants might be exposed to through CCERS activities. Using a search of publicly available sources we identified specific job titles related to three of the seven career and technical programs at the New York Harbor School and placed them in items that follow the format used by (Tyler-Wood et al., 2010). See **Error! Reference source not found.** for the research team's annotated versions of S TEM career interest items, and see **Error! Reference source not found.** for a sample of job descriptions reviewed.

Distribution

This inventory will be inserted into surveys that will be sent to student participants who were involved in the STEM Hubs, near-peer mentoring, or advanced methods training activities, as well as to comparison students who did not participate in those activities.

Survey Questions

We classify each question using the following categories:

- Goal 3. Increase awareness of and intent to pursue STEM careers
    - Broad STEM categories
    - Specific STEM job titles

STEM Career Interest Items

Question	Scale	Category and *notes*	Source
How interested are you in jobs related to science?	5=Extremely interested, 4=Very interested, 3=Moderately interested, 2=Slightly interested, 1=Not at all interested[5]	Goal 3.1.1 Interest in broad STEM categories; *count of activities*	Rating sale from (Means et al., 2017); question stem from (Tyler-Wood et al., 2010).
How interested are you in jobs related to technology?	5=Extremely interested, 4=Very interested, 3=Moderately interested, 2=Slightly interested, 1=Not at all interested	Goal 3.1.1 Interest in broad STEM categories; *count of activities*	Rating sale from (Means et al., 2017); question stem from (Tyler-Wood et al., 2010).
How interested are you in jobs related to engineering?	5=Extremely interested, 4=Very interested, 3=Moderately interested, 2=Slightly interested, 1=Not at all interested	Goal 3.1.1 Interest in broad STEM categories; *count of activities*	Rating sale from (Means et al., 2017); question stem from (Tyler-Wood et al., 2010).
How interested are you in jobs related to mathematics?	5=Extremely interested, 4=Very interested, 3=Moderately interested, 2=Slightly interested, 1=Not at all interested	Goal 3.1.1 Interest in broad STEM categories; *count of activities*	Rating sale from (Means et al., 2017); question stem from (Tyler-Wood et al., 2010).

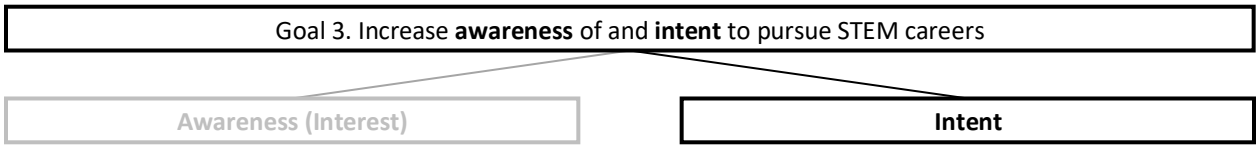
[5] The research team changed this scale to a 5-point Likert scale variable to avoid the complexity of the original items, which used count variables recoded into a dichotomous variable.

Question	Scale	Category and *notes*	Source
Please rate the following careers according to your level of interest: **Aquaculture:** • Marine Hatchery Manager (trap and hatch marine life, incubate eggs, design and maintain rearing systems); • Wastewater Engineer (conduct technical studies, computer modeling, technical report writing, design and provide construction service support for wastewater projects)	5=Extremely interested, 4=Very interested, 3=Moderately interested, 2=Slightly interested, 1=Not at all interested	Goal 3.1.2 Interest in specific STEM job titles	*Job title and description derived from:* World Aquaculture Society; indeed.com; jacobs.taleo.net
Please rate the following careers according to your level of interest: **Marine Systems Technology:** Marine System Technician (equipment installation and repair, metal fabrication, carpentry, rigging, painting)	5=Extremely interested, 4=Very interested, 3=Moderately interested, 2=Slightly interested, 1=Not at all interested	Goal 3.1.2 Interest in specific STEM job titles	*Job title and description derived from* Indeed.com
Please rate the following careers according to your level of interest: **Marine Biology Research:** • Hydrologists (study water movement, and mitigate issues related to water quality and availability) • Physical Oceanographer (study, assess, and report on the connection between the ocean/sea and land, global climate, and water quality) • Biological Technician (set up and clean laboratory equipment, collect biological samples in lab, execute experiments and tests, document test results and compose reports of findings)	5=Extremely interested, 4=Very interested, 3=Moderately interested, 2=Slightly interested, 1=Not at all interested	Goal 3.1.2 Interest in specific STEM job titles	*Job title and description derived from:* National Oceanic and Atmospheric Administration; U.S. Department of Labor, Bureau of Labor Statistics; University of North Carolina Wilmington

Question	Scale	Category and *notes*	Source
Please rate the following careers according to your level of interest: Other – please specify	5=Extremely interested, 4=Very interested, 3=Moderately interested, 2=Slightly interested, 1=Not at all interested	Goal 3.1.2 Interest in specific STEM job titles	

Intent to pursue a STEM career

- **Intent to pursue a STEM career**: This item was adapted from Estrada et al. They defined scientific integration as "intent to pursue a science-related research career."



Question	Scale	Modified scale	Category and notes	Source
To what extent do you intend to pursue a [career in science, technology, math, or engineering]? [6]	0 (definitely will not) to 10 (definitely will).	*No changes*	Intent to pursue a STEM career	(Estrada, Woodcock, Hernandez, & Schultz, 2011)

References

Estrada, M., Woodcock, A., Hernandez, P. R., & Schultz, P. W. (2011). Toward a model of social influence that explains minority student integration into the scientific community. Journal of Educational Psychology, 103(1), 206.

Fouad, N. A., Guillen, A., Harris-Hodge, E., Henry, C., Novakovic, A., Terry, S., & Kantamneni, N. (2006). Need, Awareness, and Use of Career Services for College Students. *Journal of Career Assessment*, *14*(4), 407–420. https://doi.org/10.1177/1069072706288928

Kemple, J. J., Poglinco, S. M., & Snipes, J. C. (1999). *Career Academies: Building Career Awareness and Work-Based Learning Activities through Employer Partnerships*. MDRC, 16 East 34 Street, New York, NY 10016; Tel: 212-532-3200; Web site: http://www. https://eric.ed.gov/?id=ED431111

[6] Original wording was "science related research career?"

Kier, M. W., Blanchard, M. R., Osborne, J. W., & Albert, J. L. (2014). The Development of the STEM Career Interest Survey (STEM-CIS). *Research in Science Education*, *44*(3), 461–481. https://doi.org/10.1007/s11165-013-9389-3

Means, B., Wang, H., Wei, X., Lynch, S., Peters, V., Young, V., & Allen, C. (2017). Expanding STEM opportunities through inclusive STEM-focused high schools. *Science Education*, *101*(5), 681–715. https://doi.org/10.1002/sce.21281

Richardson, J. (2003). Dual coding versus relational processing in memory for concrete and abstract words. *European Journal of Cognitive Psychology*, *15*(4), 481–509. https://doi.org/10.1080/09541440244000256

Robnett, R. D., & Leaper, C. (2013). Friendship Groups, Personal Motivation, and Gender in Relation to High School Students' STEM Career Interest. *Journal of Research on Adolescence*, *23*(4), 652–664. https://doi.org/10.1111/jora.12013

Russomanno, D., Best, R., Ivey, S., Haddock, J. R., Franceschetti, D., & Hairston, R. J. (2010). MemphiSTEP: A STEM Talent Expansion Program at the University of Memphis. *Journal of STEM Education: Innovations & Research*, *11*(1), 69–81.

Savickas, M. L., & Porfeli, E. J. (2011). Revision of the Career Maturity Inventory: The Adaptability Form. *Journal of Career Assessment*, *19*(4), 355–374. https://doi.org/10.1177/1069072711409342

Tyler-Wood, T., Knezek, G., & Christensen, R. (2010). Instruments for Assessing Interest in STEM Content and Careers. *Journal of Technology and Teacher Education*, *18*(2), 341–363.

Wigfield, A., & Eccles, J. S. (2000). Expectancy–Value Theory of Achievement Motivation. *Contemporary Educational Psychology*, *25*(1), 68–81. https://doi.org/10.1006/ceps.1999.1015

Demographic Items

Question	Scale	Category and *notes*	Source
What grade are you in? (If you are in between, please select the grade you were in most recently)	6th ◯ 7th ◯ 8th ◯ 9th ◯ 10th ◯ 11th ◯ 12th ◯	Ph2.demographics.grade	*The Mark USA Inc.*
With which gender do you most closely identify?	Male ◯ Female ◯ Do not wish to specify	Ph2. Benefits_accrue_to_URGs_in_STEM .demographics	*The Mark USA Inc.*

Question	Scale	Category and *notes*	Source
With which ethnicity do you most closely identify?	American Indian or Alaska Native ◯ Asian ◯ Black or African American ◯ Hispanic/Latino ◯ Pacific Islander or Native Hawaiian ◯ White (non-Hispanic or Latino) ◯ Other - Please specify ◯	Ph2. Benefits_accrue_to_URGs_in_STEM .demographics	*The Mark USA Inc.*
Will you be the first-generation college student if you attend college in the future? *The term "first generation college student" means: An individual both of whose parents or guardians did not complete a baccalaureate degree; OR in the case of an individual who regularly resided with and received support from only one parent or guardian, an individual whose only parent or guardian did not complete a baccalaureate degree.*	Yes ◯ No ◯ I'm not sure ◯	Ph2. Benefits_accrue_to_URGs_in_STEM .demographics	*The Mark USA Inc.*

Calculated variables:

Survey meta-evaluation items

Question	Scale	Category and *notes*	Source
Would you like to give us feedback about this survey?	Yes, I'd like to give you feedback! No. Seriously. I'm done. No	meta.eval .survey_feedback	*The Mark USA Inc.*
I hated taking this survey|I loved taking this survey	-2 -1 0 1 2	meta.eval .survey_feedback.1 .hated_loved_this_survey	*The Mark USA Inc.*
This survey was worse than most surveys I've taken|This survey was better than most survey's I've taken	-2 -1 0 1 2	meta.eval. survey_feedback.2 .worse_better_than_most_surveys	*The Mark USA Inc.*
Because of this survey, I am less interested in STEM careers|Because I took this survey I am more interested in STEM careers	-2 -1 0 1 2	meta.eval. survey_feedback.3 .less_more_interested_in_STEM_careers	*The Mark USA Inc.*

Question	Scale	Category and *notes*	Source
The text box below is for any final comments, suggestions, or complaints related to this survey that you would like to share with us.	Text box	meta.eval.survey_feedback.q	*The Mark USA Inc.*

Appendix B. Step 4 – Evaluation & Step 5 – Research surveys

Student Survey - Part 1

Welcome
Participation questions
The following questions are about activities you may have participated in during the previous 12 months. Please answer honestly, and if you're not sure whether you participated in something, feel free to select "no" or "Other". Thank you!

Logic: Show/hide trigger exists.

1) Did you participate in any activities related to oysters in the last 12 months?

- ○ No
- ○ Yes - I participated in an activity related to the Billion Oyster Project
- ○ Other (Please explain below, thanks!)

Logic: Hidden unless: #1 Question "Did you participate in any activities related to oysters in the last 12 months?" is one of the following answers ("Other (Please explain below, thanks!)")

2) **"Other" - explanation:**

Logic: Show/hide trigger exists.

3) Did you participate in a STEM summer program in the last 12 months?

- ○ No
- ○ Yes- I attended STEM Camp at PACE University in 2019
- ○ Yes- I attended STEM Camp at PACE University in 2020
- ○ Other (Please explain below, thanks!)

Image by PACE University, https://pace.edu/seidenberg/special-events/stem-camp/2018

**Logic: Hidden unless: #3 Question "Did you participate in a STEM summer program in the last 12 months?
" is one of the following answers ("Other (Please explain below, thanks!)")**

4) **"Other" - explanation:**

Logic: Show/hide trigger exists.

5) Did you participate as a *mentee* (person being mentored) in a science program in the last 12 months?*

- No
- Yes - I was a mentee at the NY Harbor School
- Yes - I was a mentee at 75 Morton
- Yes - I was a mentee at Petrides
- Yes - I was a mentee in another program (please write-in below)

Logic: Hidden unless: #5 Question "Did you participate <u>as a *mentee* (person being mentored)</u> in a science program in the last 12 months?" is one of the following answers ("Yes - I was a mentee in another program (please write-in below)")

6) **Please write in the name of the other school or organization you were mentored in.**

Image by Jeremy Von Wong, https://blog.vonwong.com/billionoysterproject/

Logic: Show/hide trigger exists.

7) Did you participate as a *mentor* in a near-peer science mentoring program in the last 12 months?*

- ○ No
- ○ Yes - I was a mentor, from NY Harbor School
- ○ Yes - I was a mentor from City-as-School
- ○ Yes - I was a mentor from Petrides
- ○ Yes - Other (Please write in below)

Logic: Hidden unless: #7 Question "Did you participate as a *mentor* in a near-peer science mentoring program in the last 12 months?" is one of the following answers ("Yes - Other (Please write in below)")

8) **Please write the school or organization you were a mentor with.**

Image by Jeremy Von Wong, https://blog.vonwong.com/billionoysterproject/

Logic: Show/hide trigger exists.

9) Did you participate in any other scientific research in the past 12 months?
*

- ○ No
- ○ Yes - DNA barcoding in cooperation with the Cold Spring Harbor Laboratory
- ○ Yes - eDNA with Dr. Alter's lab at City University of New York
- ○ Yes - Water chemistry with Dr. Branco's lab the City University of New York

- ○ Yes - Advanced monitoring and IDEXX collection with The River Project
- ○ Yes - Other (Please write in what kind of research, and who you worked on it with. Thanks!)

Image by Cold Spring Harbor Laboratory, https://cshl.edu/seeding-citizen-science-with-dna-barcoding/

**Logic: Hidden unless: #9 Question "Did you participate in any other scientific research in the past 12 months?
" is one of the following answers ("Yes - Other (Please write in what kind of research, and who you worked on it with. Thanks!)")**

10) **Other -** What kind of research did you do, and who did you do it with? (including what organization, if you can remember. Thanks!)

11) Have you participated in any other science, technology, engineering, or math-related activities in the past 12 months?

- ○ No
- ○ Yes - (Please list some of the activities you were involved in): *

Image by Jeremy Von Wong, https://blog.vonwong.com/billionoysterproject/

Action: Google Spreadsheet: Participation to Respondent Tracking Spreadsheet

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Page entry logic: This page will show when: (#7 Question **"Did you participate as a *mentor* in a near-peer science mentoring program in the last 12 months?"** is one of the following answers ("Yes - I was a mentor, from NY Harbor School","Yes - I was a mentor from City-as-School","Yes - I was a mentor from Petrides") OR (post is exactly equal to "post" AND activity_referral_from contains the string "mentor"))

Questions for Mentors

12) Please indicate how much you agree or disagree with the following statements.

*If you are on mobile, you might need to scroll to the right or hold your phone horizontally to see the "strongly agree" option.**

	1 = Strongly disagree	**2**	**3**	**4**	**5 = Strongly agree**
I feel confident I can act as a mentor to middle school students.	○	○	○	○	○
I know I can get middle school students interested in doing waterfront activities.	○	○	○	○	○
I know how to motivate younger students to think about following a career in one of the Harbor High School marine career programs.	○	○	○	○	○
I found it rewarding to work with my mentee on activities that help protect the harbor and waterfront.	○	○	○	○	○
It was satisfying to collaborate with each other in waterfront activities.	○	○	○	○	○

I feel it is important to participate in the Harbor Corps as a way to strengthen my engagement with the NY harbor and work toward a marine career.	○	○	○	○	○

Page entry logic: This page will show when: (#5 Question "**Did you participate as a *mentee* (person being mentored) in a science program in the last 12 months?**" is one of the following answers ("Yes - I was a mentee at the NY Harbor School","Yes - I was a mentee at 75 Morton","Yes - I was a mentee at Petrides") OR (post is exactly equal to "post" AND activity_referral_from contains the string "mentee"))

Questions for Mentees

13) Please indicate how much you agree or disagree with the following statements.
*If you are on mobile, you might need to scroll to the right or hold your phone horizontally to see the "strongly agree" option.**

	1 = Strongly disagree	2	3	4	5 = Strongly agree
I know more about the career programs at Harbor School after my experience with my mentor.	○	○	○	○	○
I am interested in learning about career programs in marine science and technology.	○	○	○	○	○
I am excited about doing waterfront activities with my mentor.	○	○	○	○	○
I would like to be involved in a career program at the Harbor High School that gives me opportunities to work on the waterfront.	○	○	○	○	○
I am more motivated to pursue a career in marine science and technology after my experience working with my mentor.	○	○	○	○	○
I found it rewarding to work with my mentor on activities that help protect the harbor and waterfront.	○	○	○	○	○
It was satisfying to collaborate with each other in waterfront activities.	○	○	○	○	○
I feel it is important to participate in the Harbor Corps as a way to strengthen my engagement with the NY harbor and work toward a marine career.	○	○	○	○	○

Questions for participants in scientific research

**Logic: Hidden unless: (#9 Question "Did you participate in any other scientific research in the past 12 months?
" is one of the following answers ("Yes - DNA barcoding in cooperation with the Cold Spring Harbor Laboratory","Yes - eDNA with Dr. Alter's lab at City University of New York","Yes - Water chemistry with Dr. Branco's lab the City University of New York","Yes**

- Advanced monitoring and IDEXX collection with The River Project","Yes - Other (Please write in what kind of research, and who you worked on it with. Thanks!)") OR (post is exactly equal to "post" AND activity_referral_from contains the string "advanced_methods"))

14) Please indicate how much you agree or disagree with the following statements.
*If you are on mobile, you might need to scroll to the right to see the "strongly agree" option.**

	1 = Strongly disagree	2	3	4	5 = Strongly agree
I have an understanding of what is involved in advanced level science research.	○	○	○	○	○
I feel comfortable working with advanced research procedures and protocols.	○	○	○	○	○
I think that working directly with scientists, gives me an idea about what it's like to be a scientist.	○	○	○	○	○
I'd like to find out about how I can become a scientist.	○	○	○	○	○

Page entry logic: This page will show when: (post is exactly equal to "post" AND activity_referral_from contains the string "summer")

STEM Summer Institute Feedback

Page entry logic: This page will show when: ((post is exactly equal to "post" AND activity_referral_from is exactly equal to "STEMC_Hackathon_2020") AND post_research_participation)

PACE Hackathon 2020

Logic: Hidden unless: post is exactly equal to "post"

Welcome back!

We ask that you complete the next four questions in order to give feedback on the activity you just finished. This will take less than five minutes.

All responses are compiled confidentially and reported in aggregate with all identifying information removed.

If you have any questions or comments regarding the survey, please contact:
Gaylen Moore
Moore Evaluation
gmoore1@nyc.rr.com

Logic: Hidden unless: post is not exactly equal to "post"

Note: Throughout this survey, there are no right or wrong answers. There are no more-desirable or less-desirable answers. So please answer completely honestly! Thanks!

15) How confident do you feel about building an app or game?*

	1	2	3	4	5
Not at all confident|Very confident					

16) How much do you know about tools to develop mobile apps and games?*

	1	2	3	4	5
Almost nothing|A lot					

17) How confident do you feel about building an app or game on the topic of the Billion Oyster Project? *

	1	2	3	4	5
Not at all confident|Very confident					

18) I received adequate knowledge about oyster restoration and the data science skills I needed to conduct an investigation based on data from the Billion Oyster Project.*

	1	2	3	4	5
Strongly Disagree|Strongly Agree					

Starter questions

Logic: Hidden unless: post is exactly equal to "post"

The following questions help us learn about how your activity experience affects other things that may (or may not!) be related to the activity you participated in.

Logic: Hidden unless: post is not exactly equal to "post"

Note: Throughout this survey, there are no right or wrong answers. There are no more-desirable or less-desirable answers. So please answer completely honestly! Thanks!

19) How confident do you feel about collecting and analyzing data?*

	1	2	3	4	5
Not at all confident|Very					

confident					

20) How much do you know about careers in marine, engineering, and environmental sciences?*

	1	2	3	4	5
Almost nothing|A lot					

21) How much do you know about using computer and data science to conduct a scientific investigation?*

	1	2	3	4	5
Almost nothing|A lot					

22) Do you have the skills to conduct a scientific research investigation?*

	1	2	3	4	5
Almost no skills|A lot of skills					

Logic: Hidden unless: #3 Question "Did you participate in a STEM summer program in the last 12 months?

" is one of the following answers ("Yes- I attended STEM Camp at PACE University in 2019","Yes- I attended STEM Camp at PACE University in 2020")

23) I received adequate knowledge about oyster restoration and the data science skills I needed to conduct an investigation based on data from the Billion Oyster Project.*

	1	2	3	4	5
Strongly Disagree|Strongly Agree					

Page entry logic: This page will show when: (post is exactly equal to "post" AND Student_Assent_UID)

Research participation

Logic: Show/hide trigger exists. Hidden unless: post is exactly equal to "post"

24) During the application process for the activity you just completed, you were given an opportunity to take part in research on the BOP project. Please choose the option below that best describes you:*

- I already started participating in the research, and I would like to continue.
- I haven't participated in the research, but I am interested in learning more.
- I don't want to be involved in the research at this time.

Logic: Hidden unless: (post is exactly equal to "post" AND #24 Question "During the application process for the activity you just completed, you were given an opportunity to take part in research on the BOP project. Please choose the option below that best describes you:" is one of the following answers ("I already started participating in the research, and I would like to continue."))

25) In order to match the consent form to your responses to this survey, please provide your parent or guardian's names.

*Note that we store this, and all other identifying information about you, in a separate place from your responses to the research survey questions, and with an extra layer of encryption**

	First name	Middle Initial	Last name

Parent/Guardian #1			
Parent/Guardian #2			

Page entry logic: This page will show when: post is exactly equal to "post"

Action: Google Spreadsheet: Post-Survey extra data CCERS ITEST & STEM+C Research Survey Respondent Tracking

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Thank You!

Logic: Hidden unless: #24 Question "During the application process for the activity you just completed, you were given an opportunity to take part in research on the BOP project. Please choose the option below that best describes you:" is not one of the following answers ("I haven't participated in the research, but I am interested in learning more.","I don't want to be involved in the research at this time.")

Student Survey - Part 2

Logic: Hidden unless: ((Eval_UID is exactly equal to "post" OR post is exactly equal to "post") AND post_research_participation is not exactly equal to "I haven't participated in the research, but I am interested in learning more.")

PACE UNIVERSITY

THE MARK

Welcome back!

This is the post-test portion of our research, where we measure what changes happened in the areas of interest to us. To do that, we repeat the questions we asked in our initial survey. So, if it looks familiar to you, don't worry, it's supposed to!

We do want to remind you that taking part in this study is your choice. You can decide not to take part in it or stop being in the study at any time. If you decide not to participate there will not be any penalty to you, and you will not lose any benefits to which you are otherwise entitled. Your participation or non-participation in this study will in no way affect your grades, academic standing, or any other status.

This survey will take about 10-to-20 minutes to complete. Please answer each question honestly and thoroughly. All responses are compiled confidentially and reported in aggregate with all identifying information removed. As you work through the survey, responses on each page are saved when you click the "Next" button. To view the original consent form for this study, click here.

If you have any questions or comments regarding the survey, please contact:
Dr. Lauren Birney
Principal Investigator, PACE University
(212)346-1889
lbirney@pace.edu

Technology

1) Please choose the answer that best expresses your opinion.*

	Strongly disagree	Disagree	Slightly disagree	Slightly agree	Agree	Strongly agree
I have the technical skills I need to use technology.	○	○	○	○	○	○
I can solve my own technical problems.	○	○	○	○	○	○
I feel comfortable using software programs.	○	○	○	○	○	○
I can learn a new program or application (app) independently.	○	○	○	○	○	○
I use technology in a way that enhances my everyday life.	○	○	○	○	○	○
I can learn technology easily.	○	○	○	○	○	○
I keep up with important new technologies.	○	○	○	○	○	○

Logic: Show/hide trigger exists. Hidden unless: (STEM_Summer is exactly equal to "Yes- I attended STEM Camp at PACE University in 2019" OR STEM_Summer is exactly equal to "Yes- I attended STEM Camp at PACE University in 2020")

2) Have you used the BOP digital platform? (https://platform.bop.nyc/)"*

- ○ Yes
- ○ No
- ○ I don't know
- ○ Other - Write In (Required): _____ *

Page entry logic: This page will show when: (STEM_Summer is exactly equal to "Yes- I attended STEM Camp at PACE University in 2019" OR STEM_Summer is exactly equal to "Yes- I attended STEM Camp at PACE University in 2020")

3) Please select the answer below that tells us which devices you use in school or in your life outside of school.*

	Less than once a month	Once a month	Once a week	Once a day	Multiple times a day
I have access to a smartphone.	○	○	○	○	○
I have access to a tablet that I can use at home.	○	○	○	○	○
I have access to a computer that I can use at home.	○	○	○	○	○

4) Please select the answer that best shows what you think about each of the items listed below.*

	Strongly disagree 😞	Disagree 😐	Maybe 😔	Agree 😊	Strongly agree 😃
I help my parents use their electronic devices at home.	○	○	○	○	○
If I had to choose to do homework on paper or on a tablet, I would prefer to do it on a tablet.	○	○	○	○	○
If I had to choose to do homework on paper or on a computer, I would prefer to do it on a computer.	○	○	○	○	○

5) These statements are about how you use technology in school:*

	Strongly disagree 😞	Disagree 😐	Maybe 🤨	Agree 😊	Strongly agree 😃
My teachers expect me to use websites to do my schoolwork.	○	○	○	○	○
For part of my school day, I use a computer, tablet, or I go online to do work in class.	○	○	○	○	○
In our class, we create our own excel spreadsheets or use existing excel spreadsheets to do projects.	○	○	○	○	○
I am comfortable creating and using an excel spreadsheet.	○	○	○	○	○
I feel comfortable using the internet for research, to find primary sources, or look up sources to use for papers or projects.	○	○	○	○	○
I use software programs in school that allow me to collect data.	○	○	○	○	○
I use software programs in school that allow me to make sense of data.	○	○	○	○	○
I feel comfortable using software programs.	○	○	○	○	○

Logic: Hidden unless: #2 Question "Have you used the BOP digital platform? (https://platform.bop.nyc/)"" is one of the following answers ("Yes")

6) Your feedback will help us support you and improve the program. Please select the answer that best expresses your opinion. *

	Strongly Disagree	Disagree	Slightly Disagree	Slightly Agree	Agree	Strongly Agree
I am confident I can navigate the STEM-CCE digital platform.	○	○	○	○	○	○
I find the digital platform easy to use.	○	○	○	○	○	○

Logic: Hidden unless: #2 Question "Have you used the BOP digital platform? (https://platform.bop.nyc/)"" is one of the following answers ("Yes")

7) These statements are about using the BOP internet site (digital platform) to collect and analyze data from your Oyster Restoration Station (ORS).*

	Strongly disagree 😞	Disagree 😐	Maybe 😉	Agree 😊	Strongly agree 😃
I feel comfortable entering data onto the BOP CCERS internet site (digital platform).	○	○	○	○	○
I know how to check the BOP data I enter to be sure it is correct and makes sense.	○	○	○	○	○
I know how to correct mistakes in the data that is entered on the BOP internet site	○	○	○	○	○
I can make an Excel spreadsheet with the BOP data.	○	○	○	○	○
I know how to make a graph to show the BOP data.	○	○	○	○	○
I know how to find the BOP data that I need for my research project.	○	○	○	○	○
I know how to analyze the BOP data that I need for my research project.	○	○	○	○	○

Science

8) Please choose the answer that best shows how you feel about doing each of the things listed below.*

	Strongly disagree 😞	Disagree 😐	Maybe 😉	Agree 😊	Strongly agree 😃
I can make good observations during a science activity.	○	○	○	○	○
I can ask good questions about what is happening during a science activity.	○	○	○	○	○
I feel confident about my ability to explain how to do scientific activities to others.	○	○	○	○	○
I think I could be a good scientist.	○	○	○	○	○

9)

	Strongly disagree 😞	Disagree 😐	Maybe 😉	Agree 😊	Strongly agree 😃

I want to understand science (for example, to know how computers work, how rain forms, or how airplanes fly).	○	○	○	○	○
What I learn in science is important to me because I need this for what I want to study later on.	○	○	○	○	○
I like to see how things are made (for example, ice cream, TV, iphone, energy etc.)	○	○	○	○	○
I am interested in learning about science.	○	○	○	○	○

10) Compared to most of your other activities, how useful is your learning in science class?

	1	2	3	4	5
Least useful|Most useful					

11) Please indicate how much you agree or disagree with the following statements.

	1 = Strongly disagree, 5 = Strongly agree					
	1	**2**	**3**	**4**	**5**	**N/A**
I have a sense of belonging to a community of scientists	( )	( )	( )	( )	( )	( )
I find it personally satisfying to work on a team that is doing research	( )	( )	( )	( )	( )	( )

Your career interests and activities

Again, note that there are no right or wrong answers. Just answer honestly. Thank you!

12) To what extent do you intend to pursue a career in science, technology, or engineering?

	1	2	3	4	5
Definitely will not|Definitely will					

13) Please rate the following items on a scale of 1 to 5.

	1 = Not interested at all to 5 = Very interested				
	1	**2**	**3**	**4**	**5**
How interested are you in jobs related to **science**?	( )	( )	( )	( )	( )
How interested are you in jobs related to **technology**?	( )	( )	( )	( )	( )
How interested are you in jobs related to **engineering**?	( )	( )	( )	( )	( )
How interested are you in jobs related to **mathematics**?	( )	( )	( )	( )	( )

14) Please rate the following items on a scale of 1 to 5.

	Strongly disagree 😞	**Disagree** 😐	**Maybe** 😟	**Agree** 😊	**Strongly agree** 😃
I am interested in learning more about possible careers in environmental science.	○	○	○	○	○
Some day when I tell others about my career, they will respect me for doing scientific work.	○	○	○	○	○
Scientists make a meaningful difference in the world.	○	○	○	○	○
A career in science would enable me to work with others in meaningful ways.	○	○	○	○	○
I will have a successful professional career and make substantial scientific contributions.	○	○	○	○	○

15) Please rate your interest in the following items on a scale of 1 to 5.

These jobs listed below are ones that you can get with a community college certificate or associate degree. *

	1 = Not interested at all to 5 = Very interested					
	1*	**2***	**3***	**4***	**5***	**NA***
Wastewater Engineer Conduct technical studies, computer modeling, technical report writing, design and provide construction service support for wastewater projects	( )	( )	( )	( )	( )	( )
Marine System Technician Equipment installation and repair, metal fabrication, carpentry, rigging, painting	( )	( )	( )	( )	( )	( )
Hydrologist Study water movement, and mitigate issues related to water quality and availability	( )	( )	( )	( )	( )	( )

Biological Technician Set up and clean laboratory equipment, collect biological samples in lab, execute experiments and tests, document test results and compose reports of findings	( )	( )	( )	( )	( )	( )

Your activities related to STEM Careers

The following questions are about things related to science, technology, engineering, or math that you may or may not have done outside of the classroom.

Logic: Hidden unless: Eval_UID is exactly equal to "post"

We are asking these questions again to understand what STEM-related activities you may have been involved in since you took the research pre-survey.

Logic: Show/hide trigger exists.

16) Have you interned or worked in a science, technology, engineering and/or math field?*

- Yes
- No
- No change from when I took the pre-survey

17) Please select all the activities you participated in, in the last 12 months:*

	Yes	No	No change from when I took the pre-survey
Participated in extracurricular activities involving robotics or engineering			
Volunteered in a science, technology, engineering and/or math field			
Volunteered in a field related to environmental cleanup and restoration, including environmental activism			
Participated in any science fairs or tournaments			

Logic: Show/hide trigger exists.

18) Have you job-shadowed someone in a science, technology, engineering and/or math field in the past 4 years?*

- Yes

○ No

○ No change from when I took the pre-survey

19) The following questions are about other people in your life who provide guidance on how to prepare for a job in a scientific field. *

	Yes	No
Are there family members who provide you with guidance on preparing for a job in science?	○	○
Are there mentors outside of your home who provide guidance on preparing for a job in science?	○	○

Page entry logic: This page will show when: (((OR Question "Volunteered in a science, technology, engineering and/or math field" is one of the following answers ("Yes")) OR Question "Volunteered in a field related to environmental cleanup and restoration, including environmental activism" is one of the following answers ("Yes")) OR Question "Participated in any science fairs or tournaments" is one of the following answers ("Yes"))

Followup on activities you have been involved in
Thanks for letting us know about some of your science-related activities. The following questions ask about some more details on the activities you indicated you were involved in above.

We know this could be a lot of questions, especially if you're very involved in science-related activities, so we really appreciate you taking the time to give us the details.

Validation: Must be numeric Whole numbers only

Logic: Hidden unless: (((Question "Participated in extracurricular activities involving robotics or engineering" is one of the following answers ("Yes") OR Question "Volunteered in a science, technology, engineering and/or math field" is one of the following answers ("Yes")) OR Question "Volunteered in a field related to environmental cleanup and restoration, including environmental activism" is one of the following answers ("Yes")) OR Question "Participated in any science fairs or tournaments" is one of the following answers ("Yes"))

20) This question is about your experience participating in corresponding activities. Please answer by typing a number in the following textboxes.

Please type in a period (".") if you don't want to answer a question.

	Enter number here
Number of science fairs or tournaments participated in the last 12 months	
Number of awards received at science fairs or tournaments in the last 12 months	

Number of extracurricular activities involving computer coding in the last 12 months	
Number of extracurricular activities involving robotics or engineering in the last 12 months	
Number of extracurricular activities involving astronomy in the last 12 months	
Number of extracurricular activities involving using Excel or Google Sheets for statistics in the last 12 months	

Engagement with Scientists
The following questions have to do with how much interaction you have had with scientists.

21) How would you rate your level of engagement with scientists in general?*

	1	2	3	4	5
Not at all engaged with scientists | Extremely engaged with scientists					

22) Have you participated in any of the following in the last 12 months:*

	Yes	No	No change from when I took the pre-survey
Received direct guidance on projects from a scientist	○	○	○
Watched videos made by scientists (For example, YouTubers Veritassium, Mark Rober, Smarter Every Day)	○	○	○
Attended any talks where a scientist spoke	○	○	○
Read articles written by scientists	○	○	○
Listen to podcasts by scientists	○	○	○

Logic: Show/hide trigger exists.

23) Do you or your family have acquaintances who are scientists?
Note: an acquaintance is a person you know who doesn't have to be a friend. For example, a neighbor can be an acquaintance.

- Yes
- No
- No change from when I took the pre-survey

Logic: Hidden unless: ((((((Question "Received direct guidance on projects from a scientist" is one of the following answers ("Yes") OR Question "

Watched videos made by scientists
(For example, YouTubers Veritassium, Mark Rober, Smarter Every Day)
" is one of the following answers ("Yes")) OR Question "Attended any talks where a scientist spoke" is one of the following answers ("Yes")) OR Question "Read articles written by scientists" is one of the following answers ("Yes")) OR Question "Listen to podcasts by scientists" is one of the following answers ("Yes")) OR Question "Do you have family members who are scientists?" is one of the following answers ("Yes")) OR #23 Question "Do you or your family have acquaintances who are scientists?
***Note: an acquaintance is a person you know who doesn't have to be a friend. For example, a neighbor can be an acquaintance." is one of the following answers ("Yes"))**

Details about your engagement with scientists
Thanks again for letting us know about your interaction with scientists. Again, we'd love to get some more details from you.

You're almost done, just one more section after this!

Validation: Must be numeric Whole numbers only Positive numbers only

Logic: Hidden unless: Question "

Watched videos made by scientists
(For example, YouTubers Veritassium, Mark Rober, Smarter Every Day)
" is one of the following answers ("Yes")

24) How many videos made by scientists do you watch **in an average month?**

Validation: Must be numeric Whole numbers only Positive numbers only

Logic: Hidden unless: Question "Attended any talks where a scientist spoke" is one of the following answers ("Yes")

25) How many talks have you attended where a scientist spoke **in the last 12 months**?

Validation: Must be numeric Whole numbers only Positive numbers only

Logic: Hidden unless: Question "Read articles written by scientists" is one of the following answers ("Yes")

26) How many **articles written by scientists** do you read **in an average month?**

Validation: Must be numeric Whole numbers only Positive numbers only

Logic: Hidden unless: Question "Listen to podcasts by scientists" is one of the following answers ("Yes")

27) How many **podcasts led by scientists** do you listen to **in an average month?**

Demographic Questions

We are asking you about these demographic questions to find out if our project activities are having a positive effect on people from groups who have been under-represented in the national science, technology, engineering, and mathematical workforce.

We would like to remind you that all of these questions are optional, you may choose to stop your participation at any time.

28) What grade are you in?
(If you are in between, please select the grade you were in most recently)

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

29) With which gender do you most closely identify?

- Male
- Female
- Do not wish to specify

30) With which ethnicity do you most closely identify?

- American Indian or Alaska Native
- Asian
- Black or African American
- Hispanic/Latino
- Pacific Islander or Native Hawaiian
- White (non-Hispanic or Latino)
- Other - Please specify: [ ] *

31) Will you be the first-generation college student if you attend college in the future?
The term "first generation college student" means: An individual both of whose parents or guardians did not complete a baccalaureate degree; OR in the case of an individual who regularly resided with and received support from only one parent or guardian, an individual whose only parent or guardian did not complete a baccalaureate degree.

- Yes
- No
- I'm not sure

32) Would you like to give us feedback about this survey?

- Yes, I'd like to give you feedback!
- No. Seriously. I'm done.
- No.

Logic: Hidden unless: (#32 Question "Would you like to give us feedback about this survey? " is one of the following answers ("Yes, I'd like to give you feedback!") OR Question "Survey feedback branch" is one of the following answers "Always show feedback questions")

33) How would you rate this survey on the following metrics?

	-2	-1	0	1	2
I hated taking this survey | I loved taking this survey					
This survey was worse than most surveys I've taken | This survey was better than most survey's I've taken					
Because of this survey, I am **less interested** in STEM careers | Because I took this survey I am **more**					

interested in STEM careers					

34) The text box below is for any final comments, suggestions, or complaints related to this survey that you would like to share with us.

Page entry logic: This page will show when: (((Student_Survey_UID AND Student_Assent_UID) AND Parental_Consent_UID) AND Eval_UID)

Thank you

Thank You! We appreciate the time you have taken to complete this survey. All of your responses are confidential and will be reported as an aggregate of all responses.

If you have any questions, please feel free to contact me at the following email address.

Joshua Penman, Senior Evaluator
The Mark USA
jpenman@themarkusa.com

Page entry logic: This page will show when: (((((Student_Survey_UID AND Student_Assent_UID) AND Parental_Consent_UID) AND Pre_Approval_UID) AND consentvar) AND reward is one of the following answers "khamsa5,ashera10")

Rewards

Page entry logic: This page will show when: Parental_Consent_UID

Parental consent needed
We appreciate the time you have taken to complete this survey. All of your responses are confidential and will be reported as an aggregate of all responses.

Here are your next steps:

1. **We do not have a parental consent connected to your response.** This is required for participation.

2. If your parent or guardian is not available right now, please save the link below to return to the same place when they are ready. Otherwise, you will have to begin again.

   http://www.surveygizmo.com/s3/4896577/Student-Survey//?snc=[survey('session id')]

If you have any questions, or you know that the parent or guardian consent was filled out and somehow got unlinked from your response, please feel free to contact me at the following email address:

Joshua Penman, Senior Evaluator
The Mark USA
jpenman@themarkusa.com
CC: gabdelsalam@themarkusa.com
To go to the parental consent form click "Submit" below:

Thank You!

Logic: Hidden unless: Parental_Consent_UID

Thank You!

You are being redirected to the Parental Consent survey.

Appendix C. Individual item tables & charts

Please note that the analyses completed in this section pertains to data collected on 1/14/21 that may have been slightly updated since collection. The data revisions however are not significant enough to influence the reported findings in this report.

Overall frequencies of participant groups:

Row Labels	Count of Treatment_group.L1.nsf_project_or_activity_referral_from.Participation
Comparison Group - general link	78
Comparison Group - NY Aquarium	26
ITEST (Ph2)	6
STEM+C (Ph3)	11
Grand Total	121

Rewards for participant groups:

Participant group	Count of reward
Comparison Group - general link	9
Comparison Group - NY Aquarium	26
ITEST (Ph2)	
STEM+C (Ph3)	
(blank)	
Grand Total	35

Evaluation

Do you have the skills to conduct a scientific research investigation? [Skills to conduct scientific research (evaluation)]

Participant group	Almost none (1)	2	3	4	A lot (5)
Comparison Group - general link (n=2)	1			1	
Comparison Group - NY Aquarium					

ITEST (Ph2)	
STEM+C (Ph3)	

How confident do you feel about collecting and analyzing data? [collecting_analyzing_data:confidence (evaluation)]

Participant group	Almost none (1)	2	3	4	A lot (5)
Comparison Group - general link (n=2)	1			1	
Comparison Group - NY Aquarium					
ITEST (Ph2)					
STEM+C (Ph3)					

How much do you know about careers in marine, engineering and environmental sciences?
[knowledge_careers_in_marine_engineer_and_environ_sciences:knowledge_careers.eval.Ph3 (evaluation)]

Participant group	1	2	3	4	5
Comparison Group - general link (n=2)	1				1
Comparison Group - NY Aquarium					
ITEST (Ph2)					
STEM+C (Ph3)					

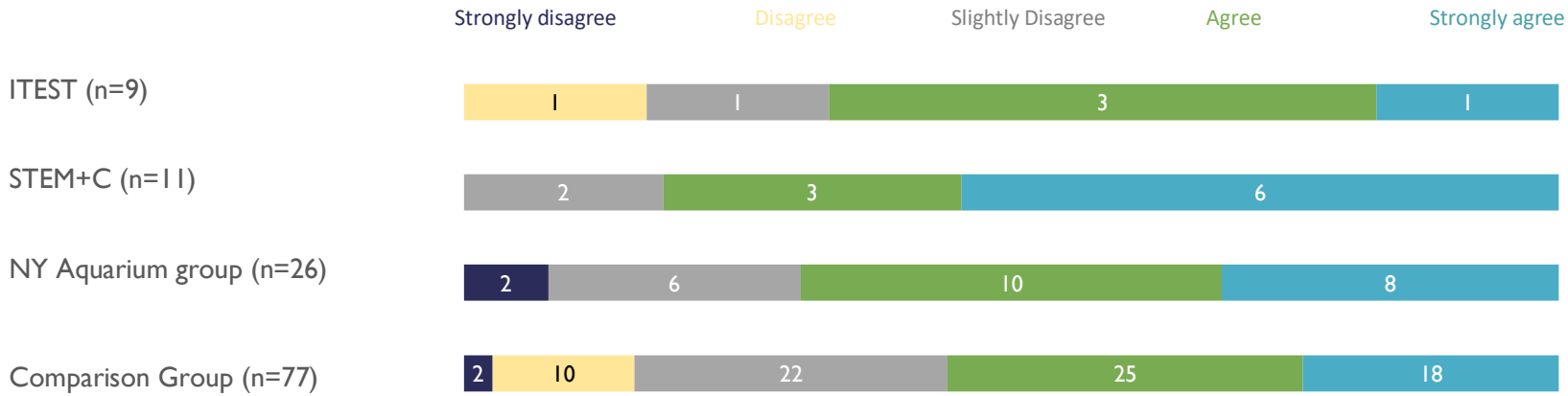
How much do you know about using computer and data science to conduct a scientific research investigation?
[how_much_know_about_using_data_science_to_conduct_research:eval.Ph3 (evaluation)]

Participant group	1	2	3	4	5
Comparison Group - general link (n=2)	1				1
Comparison Group - NY Aquarium					
ITEST (Ph2)					
STEM+C (Ph3)					

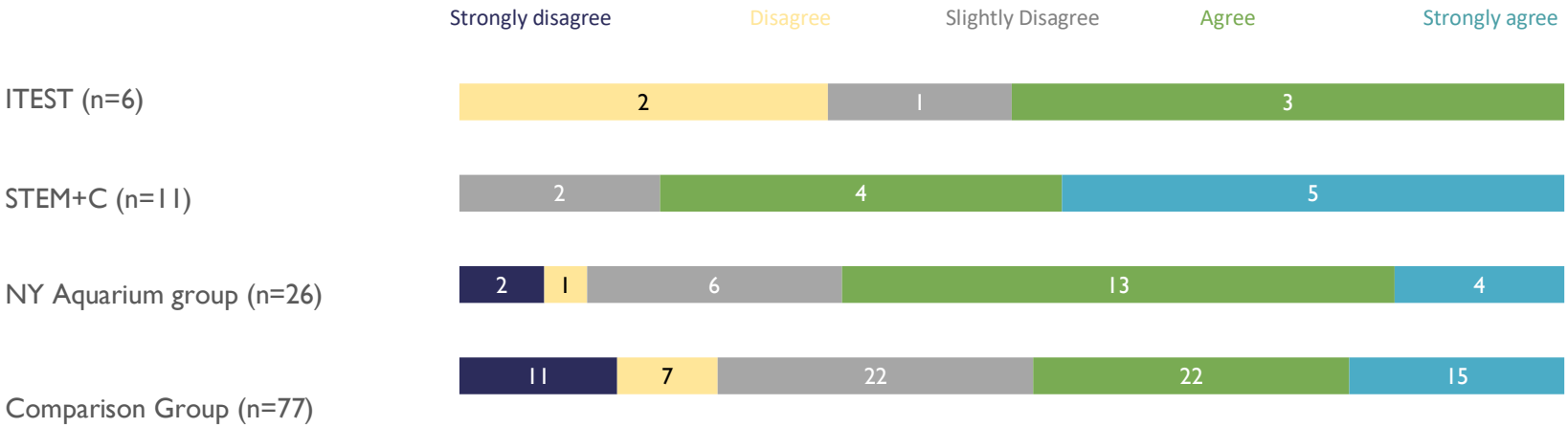
Research

Increased STEM Competency (Student Learning)

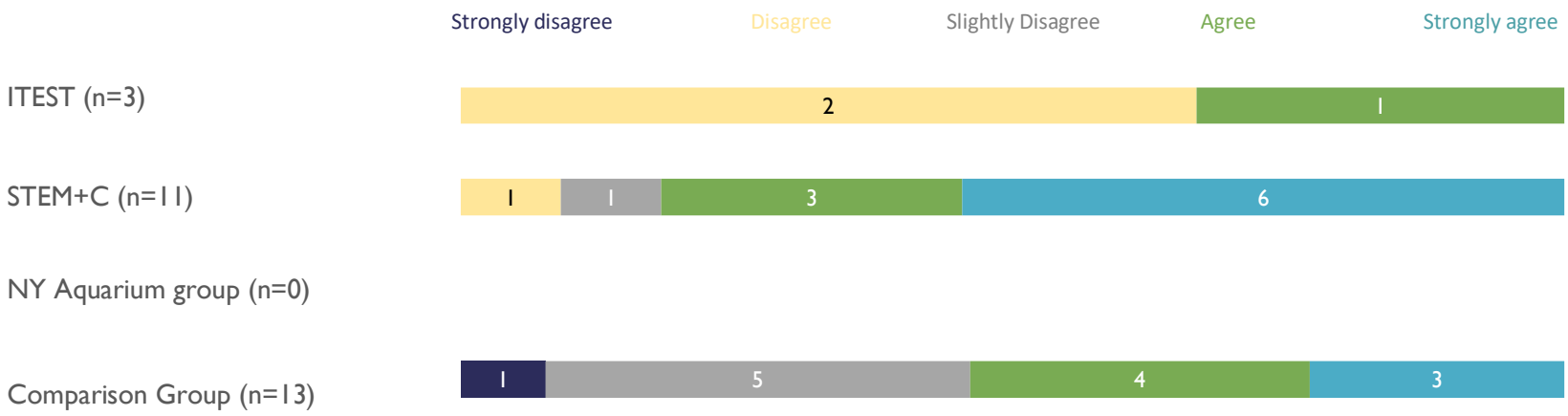
1. **Please choose the answer that best expresses your opinion: I have the technical skills I need to use technology**



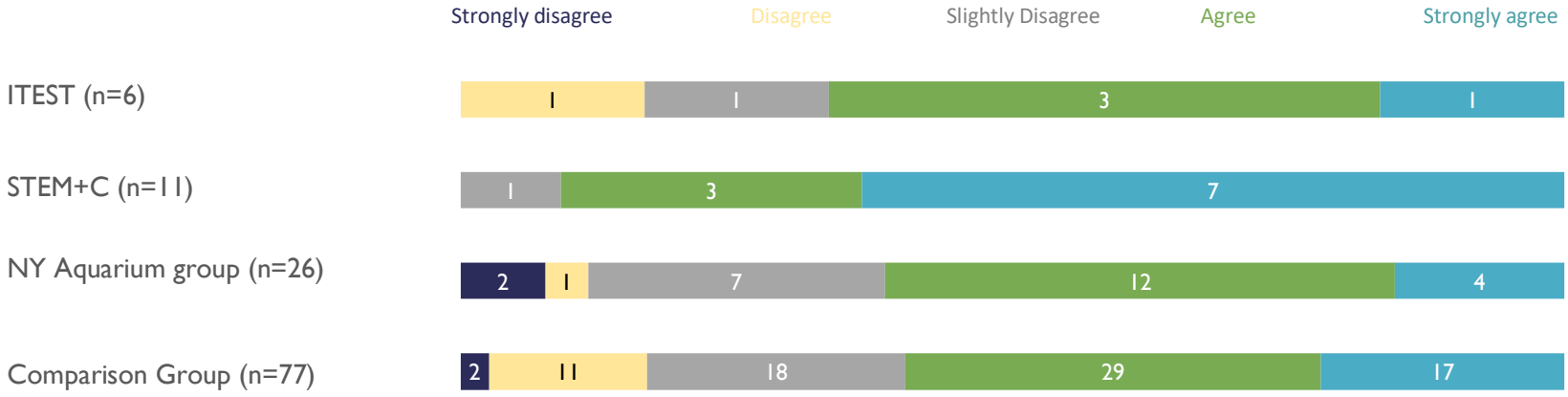
2. **Please choose the answer that best expresses your opinion: I can solve my own technical problems.**



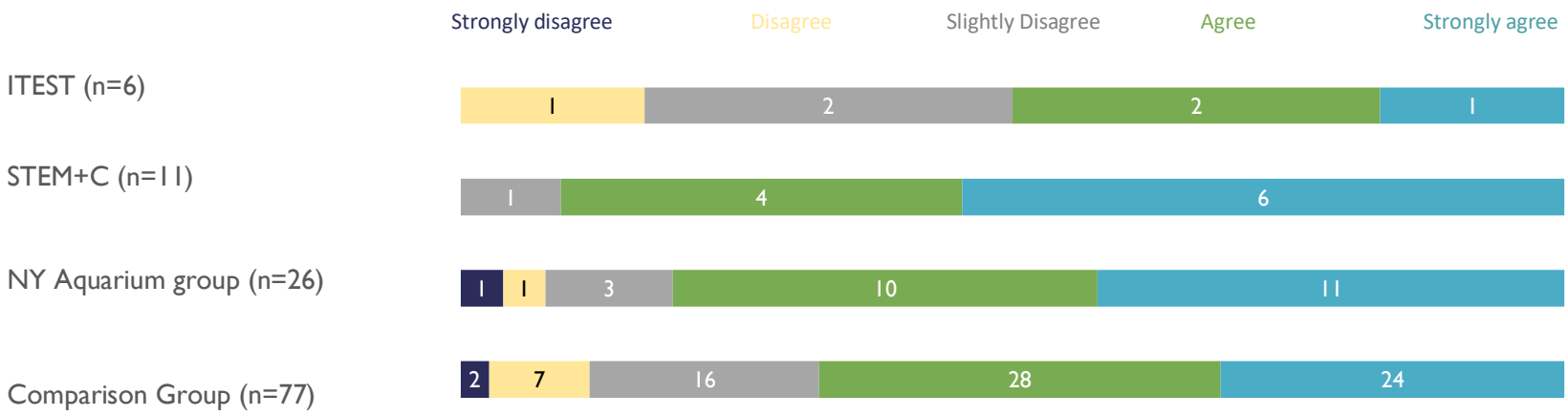
3. **Please choose the answer that best expresses your opinion: I feel comfortable using program software.**



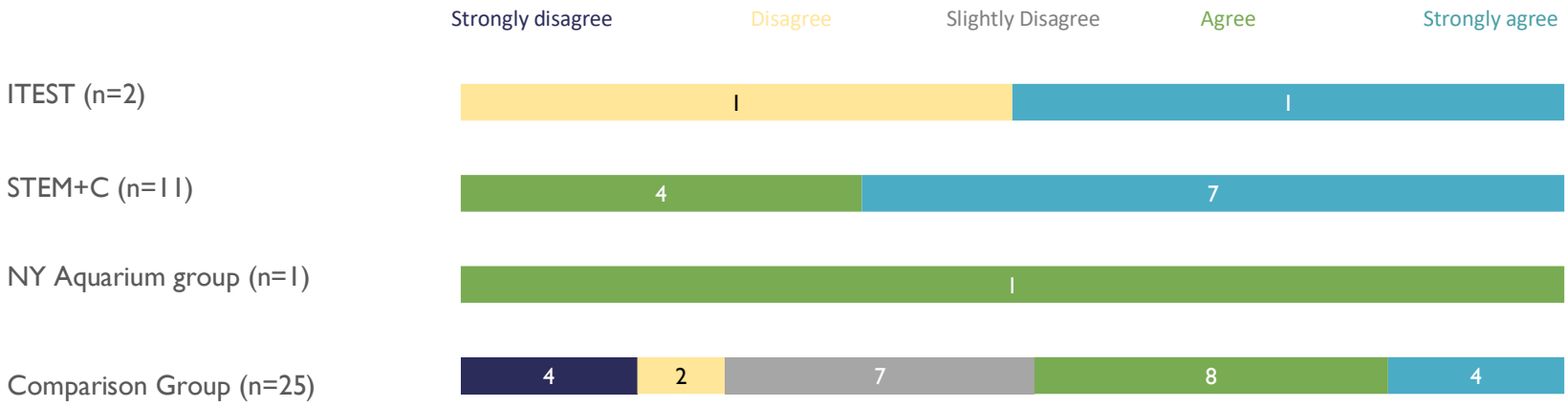
4. **Please choose the answer that best expresses your opinion: I can learn a new program or application (app) independently.**



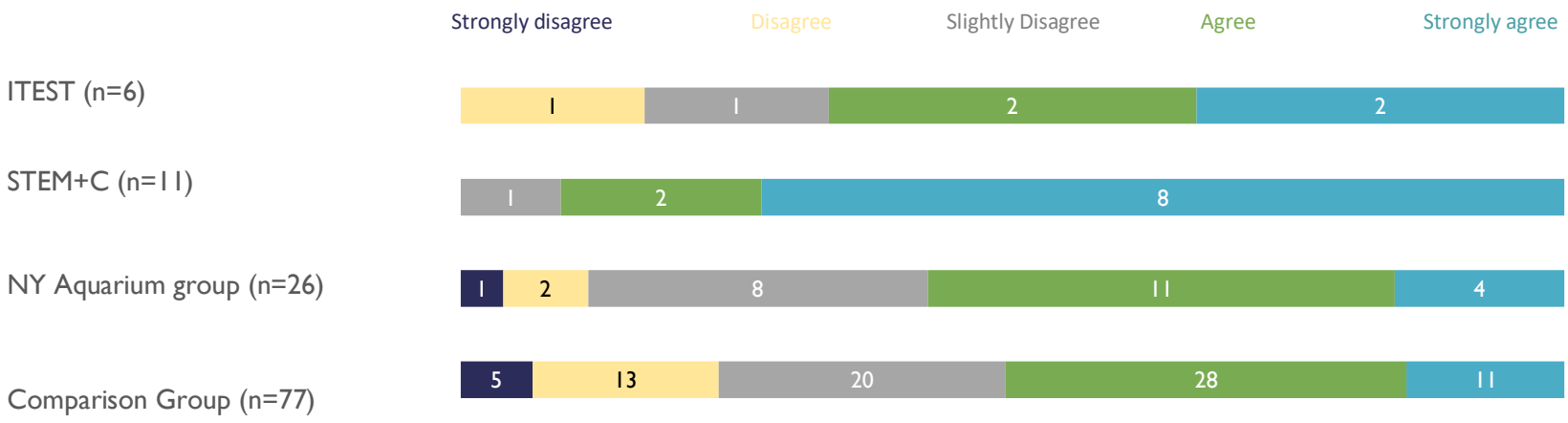
5. **Please choose the answer that best expresses your opinion: I use technology in a way that enhances my everyday life.**



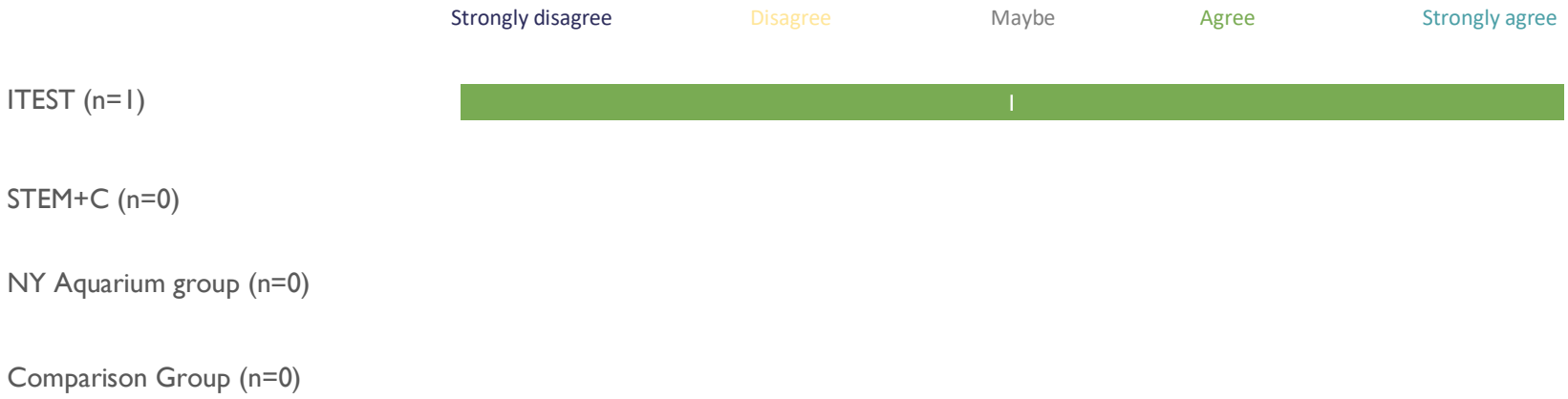
6. **Please choose the answer that best expresses your opinion: I can learn technology easily.** [ph3.Preparation to pursue STEM



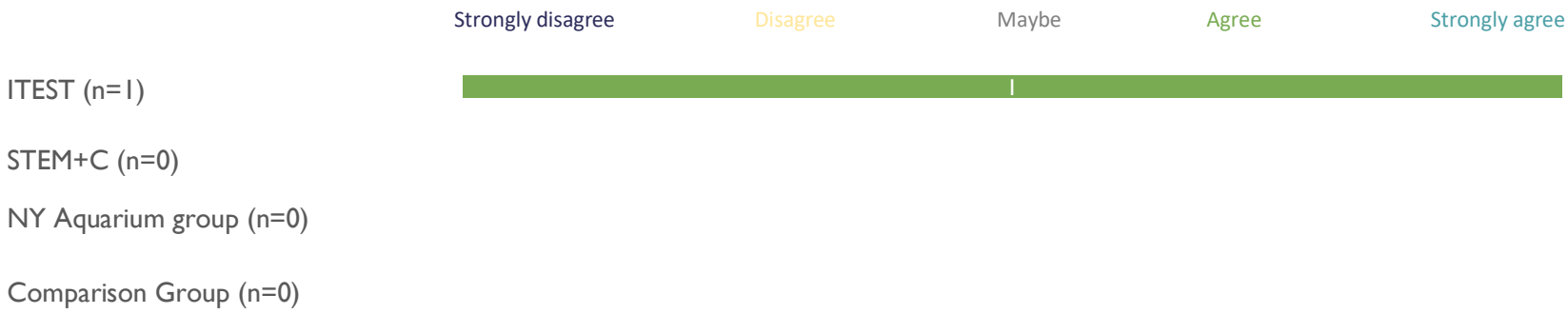
7. **Please choose the answer that best expresses your opinion: I keep up with important new technologies.**



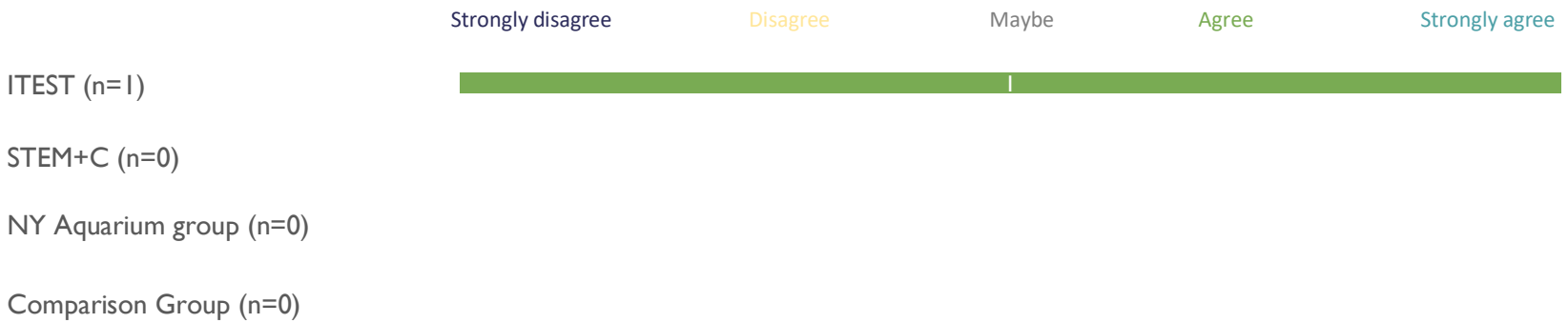
8. **I help my parents use their electronic devices at home.**



9. **Please select the answer that best shows what you think about each of the items listed below: If I had to choose to do homework on paper or on a tablet, I would prefer to do it on a tablet.**

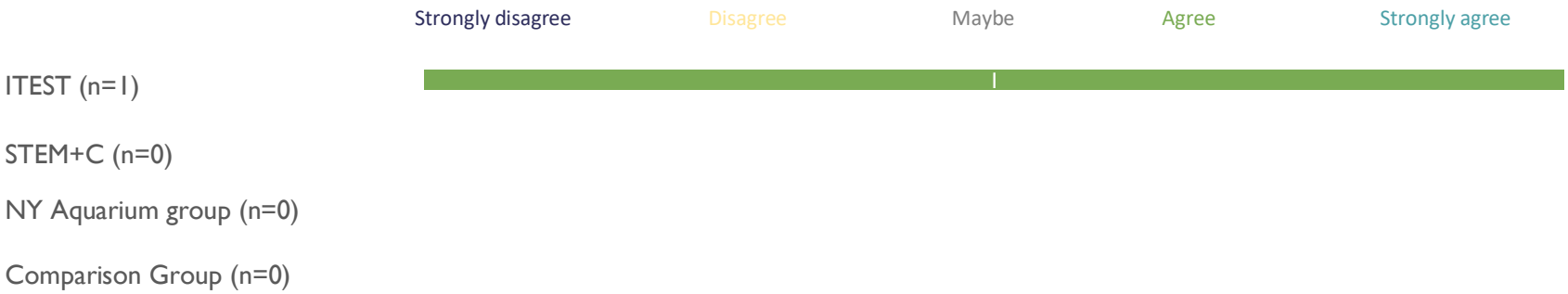


10. **Please select the answer that best shows what you think about each of the items listed below: If I had to choose to do homework on paper or on a computer, I would prefer to do it on a computer.**

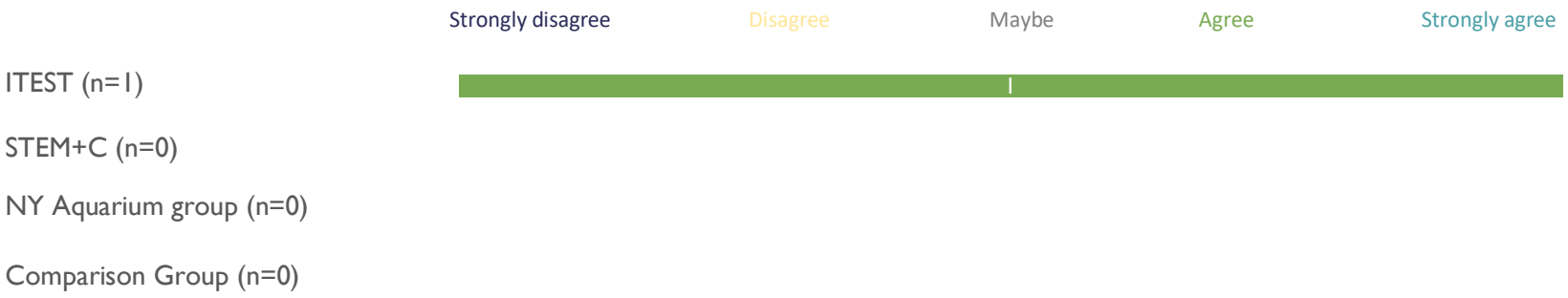


11. **These statements are about how you use technology in school: My teachers expect me to use websites to do my schoolwork.**

12. **These statements are about how you use technology in school: For part of my school day, I use a computer, tablet, or I go online to do work in class.**

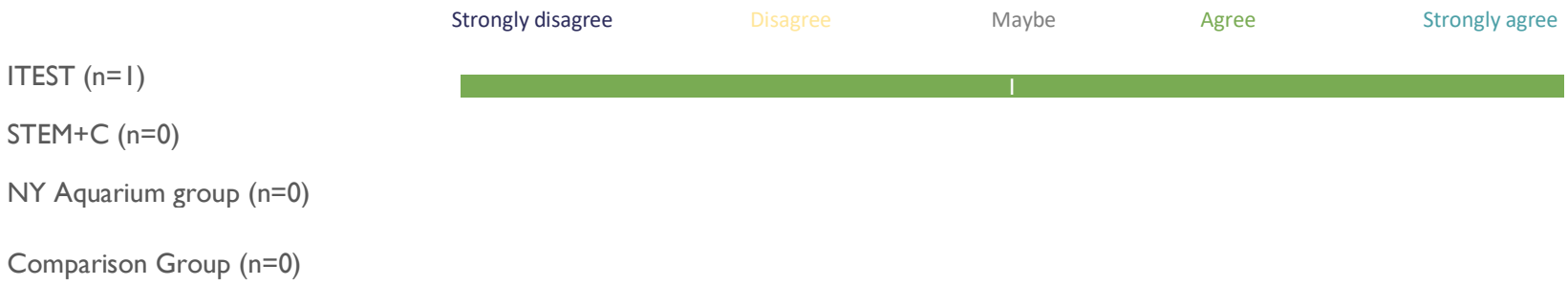


13. **These statements are about how you use technology in school: In our class, we create our own excel spreadsheets or use existing excel spreadsheets to do projects.**

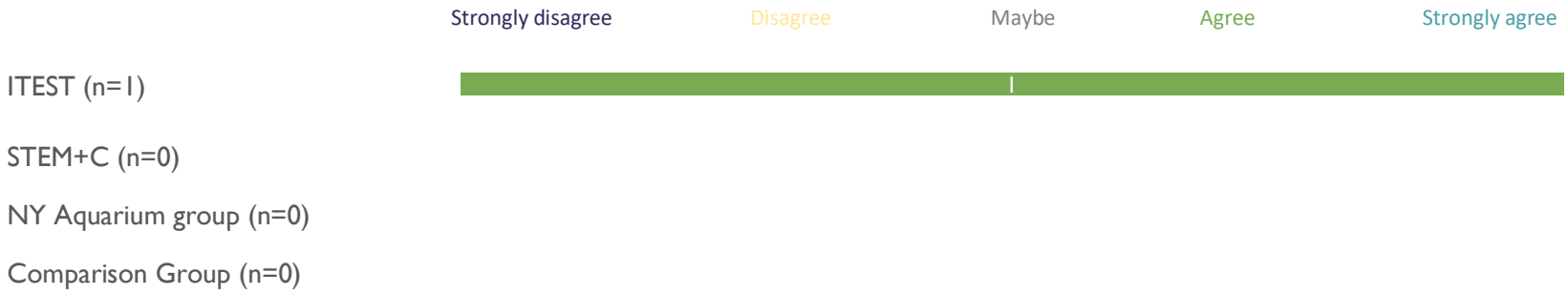


14. **These statements are about how you use technology in school: I am comfortable creating and using an excel spreadsheet.**

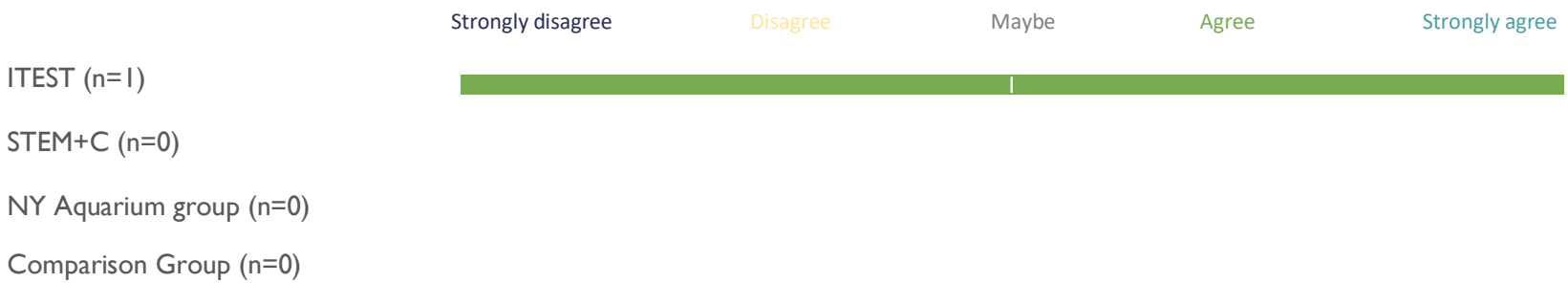
15. **These statements are about how you use technology in school: I use software programs in school that allow me to collect data.**



16. **These statements are about how you use technology in school: I use software programs in school that allow me to make sense of data.**



17. **These statements are about how you use technology in school: I feel comfortable using software programs.**



18. **These statements are about using the BOP internet site (digital platform) to collect and analyze data from your Oyster Restoration Station (ORS): I feel comfortable entering data onto the BOP CCERS internet site (digital platform).**
No responses.

19. **These statements are about using the BOP internet site (digital platform) to collect and analyze data from your Oyster Restoration Station (ORS): I know how to check the BOP data I enter to be sure it is correct and makes sense.**
No responses.

20. **These statements are about using the BOP internet site (digital platform) to collect and analyze data from your Oyster Restoration Station (ORS): I know how to correct mistakes in the data that is entered on the BOP internet site.**
No responses.

21. **These statements are about using the BOP internet site (digital platform) to collect and analyze data from your Oyster Restoration Station (ORS): I can make an Excel spreadsheet with the BOP data.**
No responses.

22. **These statements are about using the BOP internet site (digital platform) to collect and analyze data from your Oyster Restoration Station (ORS): I know how to make a graph to show the BOP data.**
No responses.

23. **These statements are about using the BOP internet site (digital platform) to collect and analyze data from your Oyster Restoration Station (ORS): I know how to make a graph to show the BOP data.**

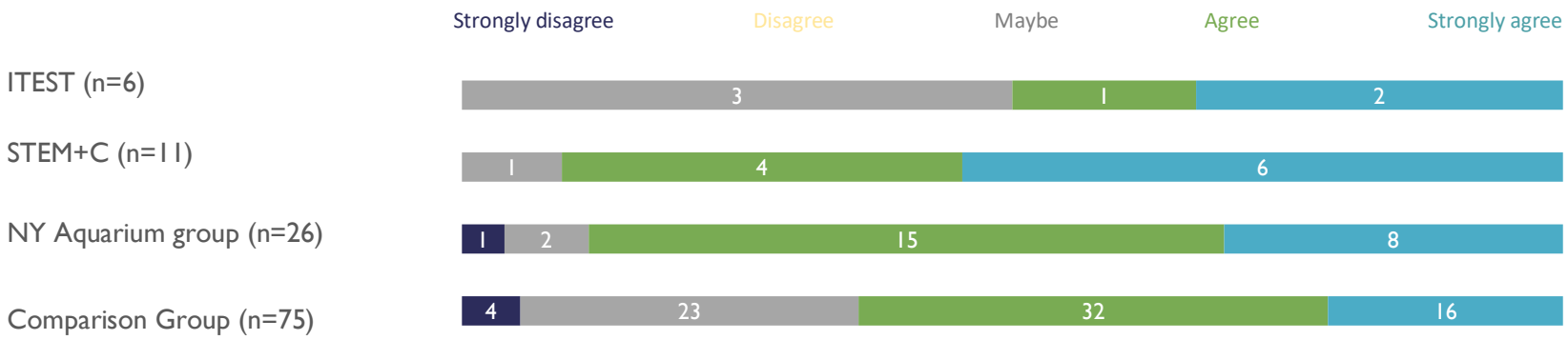
No responses.

24. **These statements are about using the BOP internet site (digital platform) to collect and analyze data from your Oyster Restoration Station (ORS): I know how to analyze the BOP data that I need for my research project.**

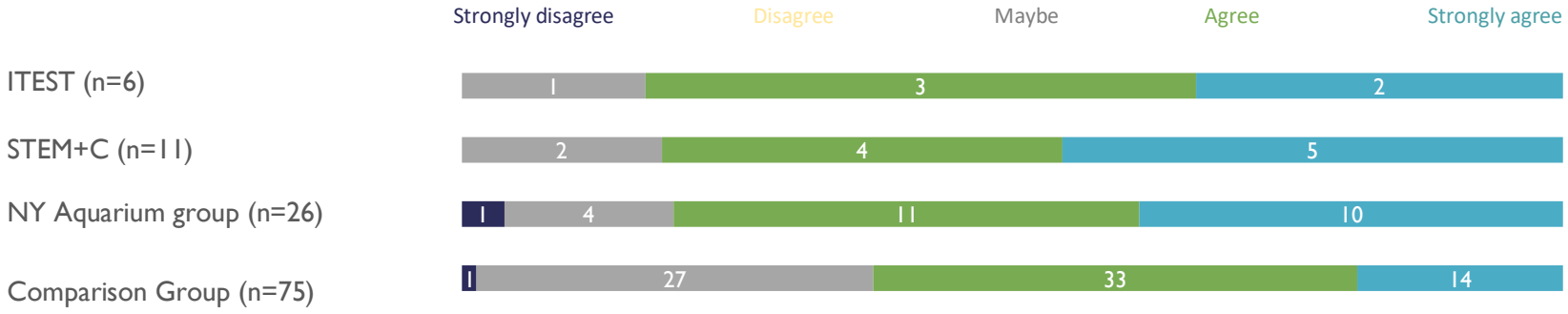
No responses.

Self-efficacy

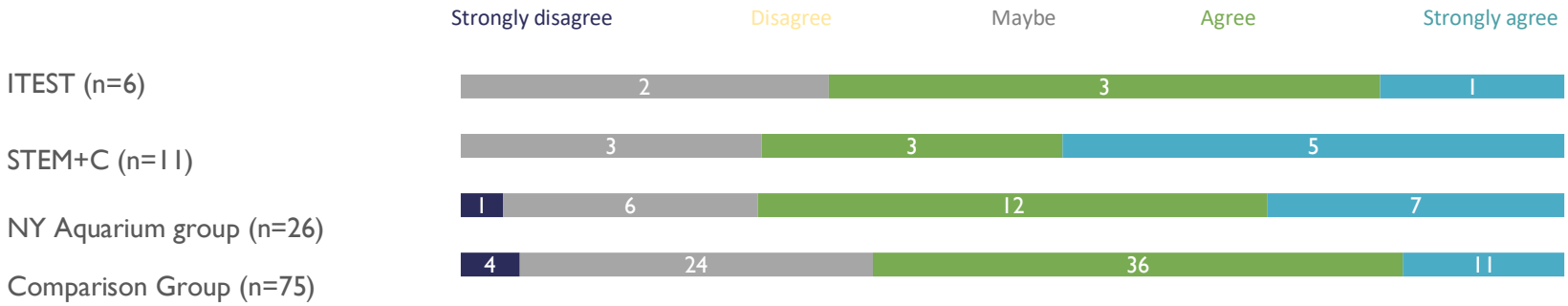
1. **Please choose the answer that best shows how you feel about doing each of the things listed below: I can make good observations during a science activity.**



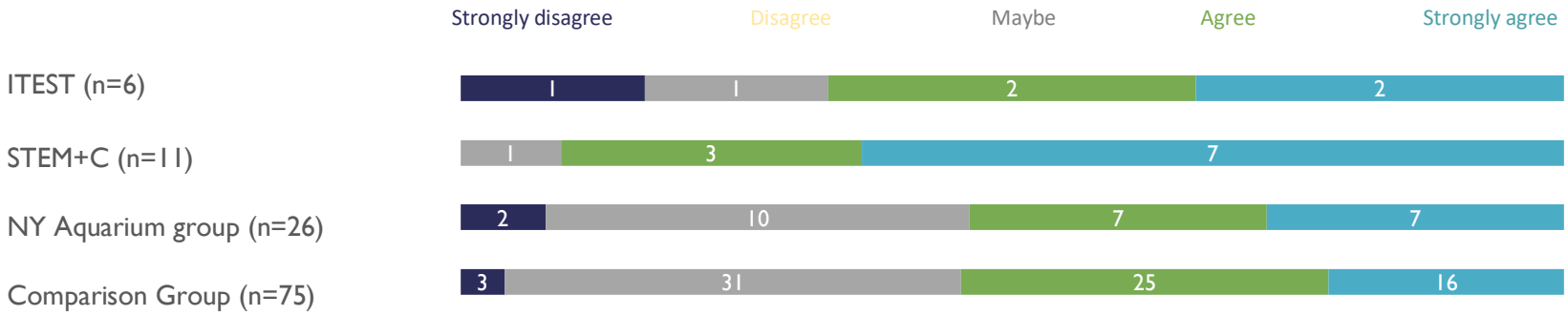
2. **Please choose the answer that best shows how you feel about doing each of the things listed below: I can ask good questions about what is happening during a science activity.**



3. **Please choose the answer that best shows how you feel about doing each of the things listed below: I feel confident about my ability to explain how to do scientific activities to others.**

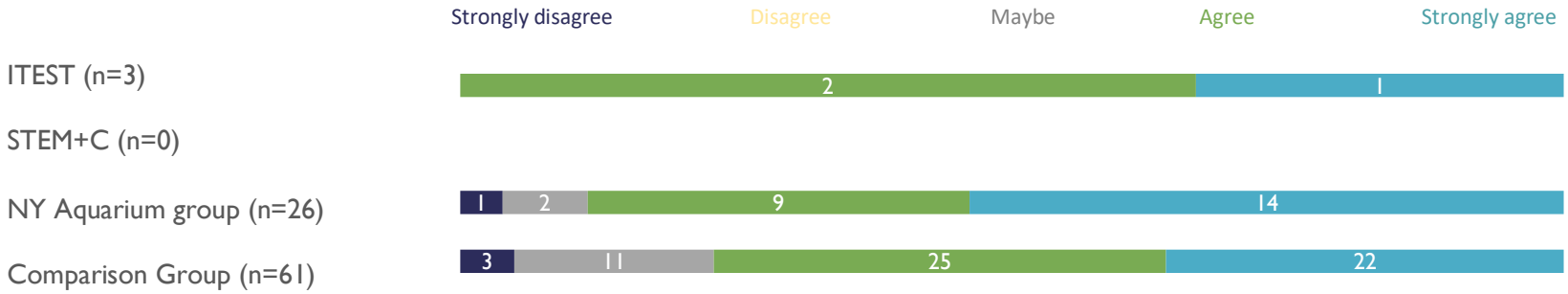


4. **Please choose the answer that best shows how you feel about doing each of the things listed below: I think I could be a good scientist.**

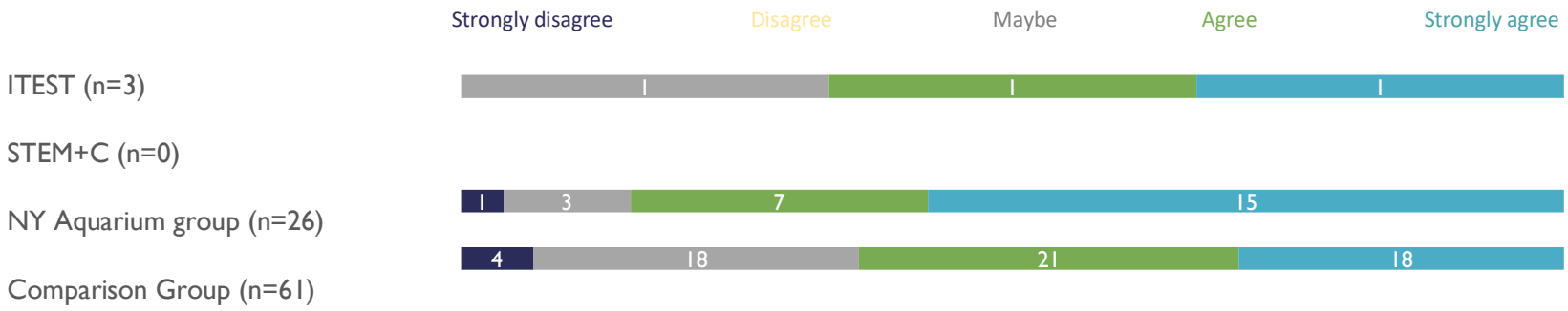


Motivation to Pursue STEM Careers

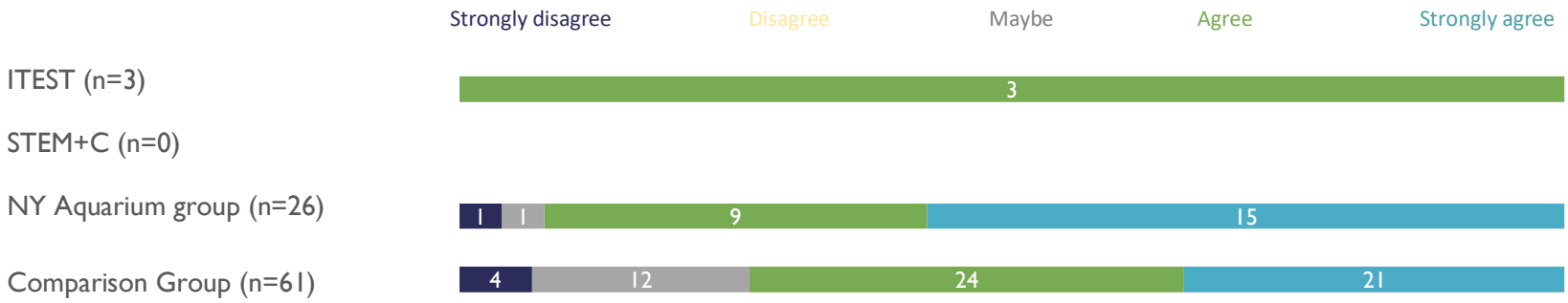
1. **I want to understand science (for example, to know how computers work, how rain forms, or how airplanes fly)**



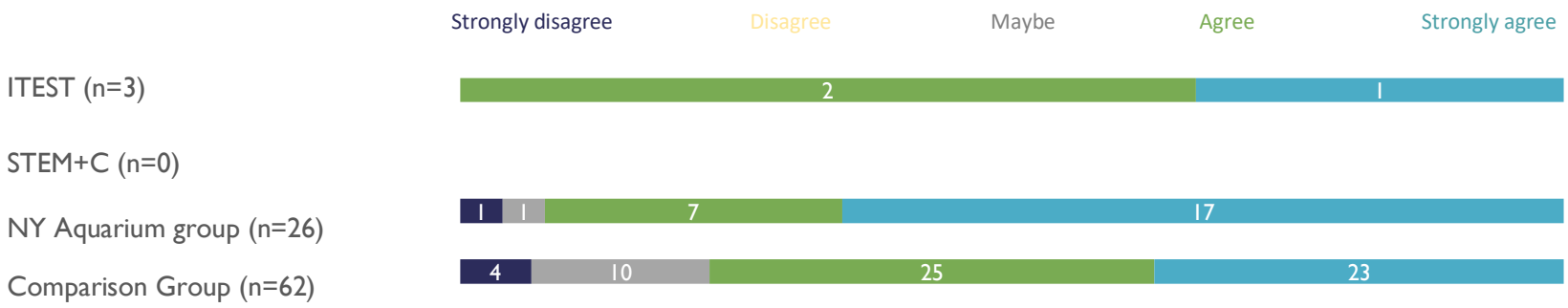
2. **What I learn in science is important to me because I need this for what I want to study later on.**



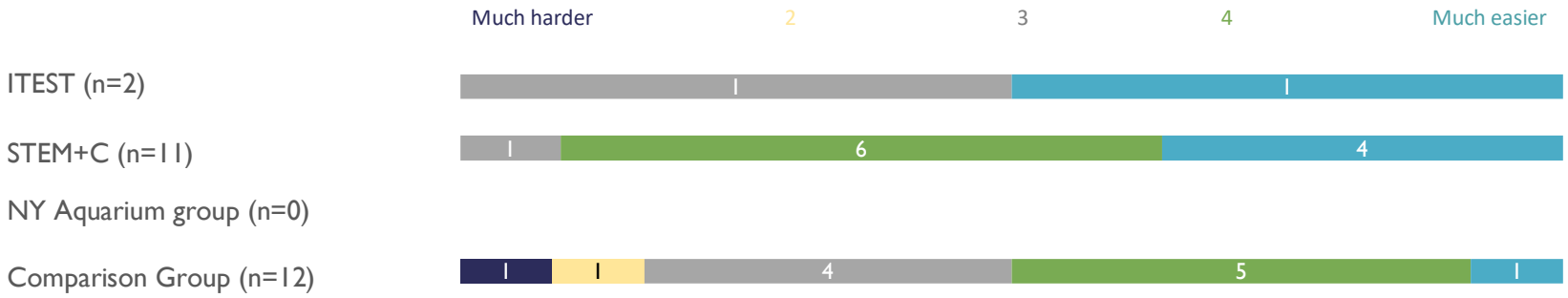
3. **I like to see how things are made (for example, ice cream, TV, iphone, energy etc.)**



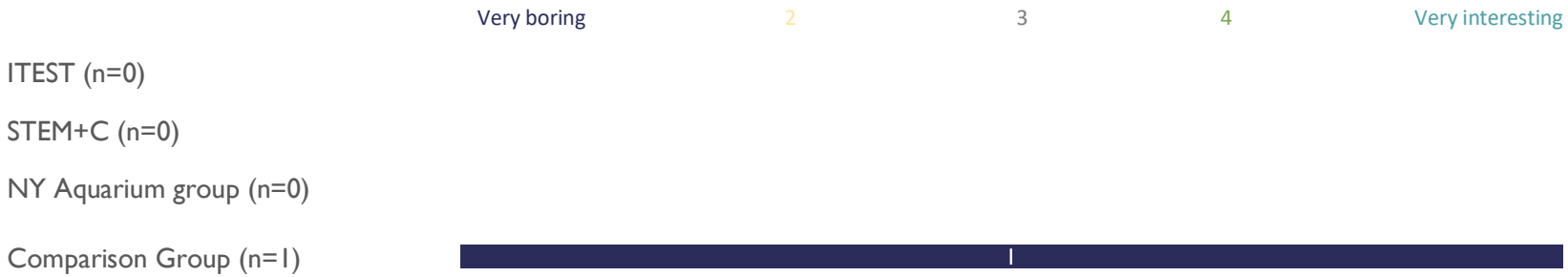
4. **I am interested in learning about science.**



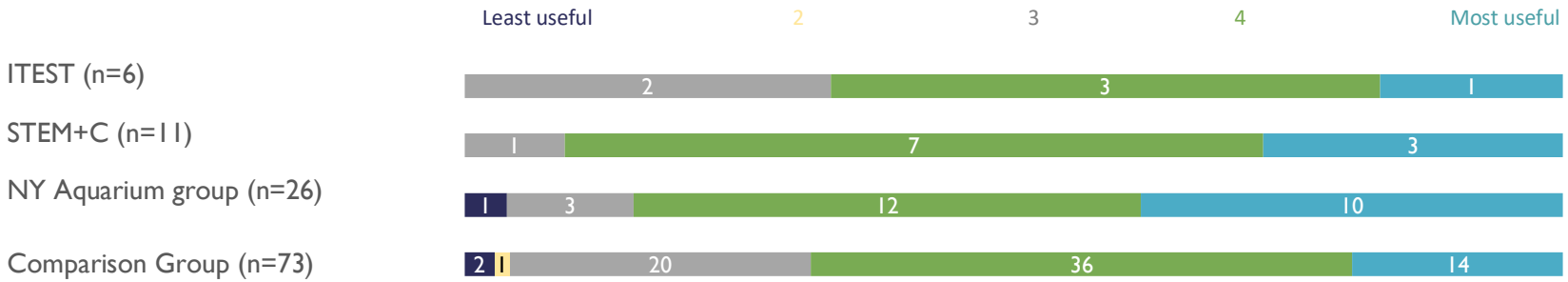
5. **Compared to most other students in your classes, how hard is science for you?**



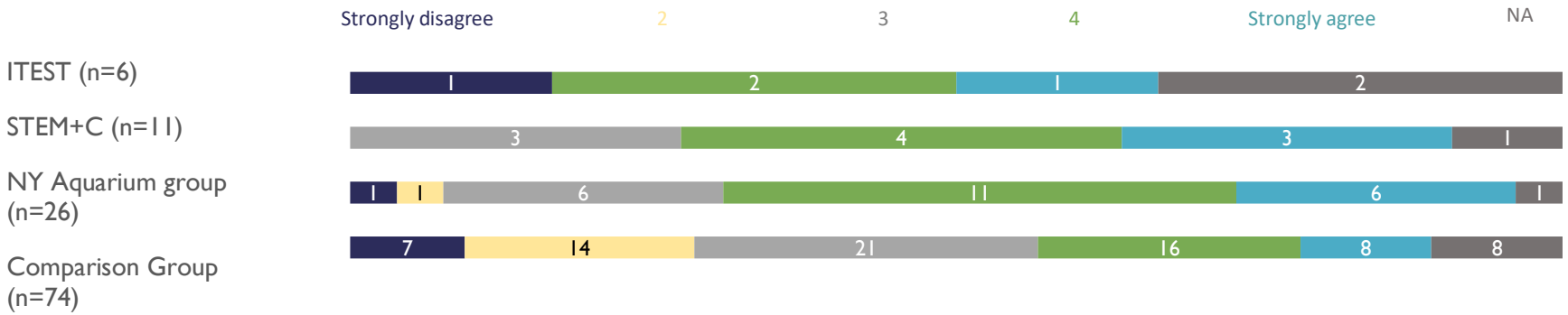
6. **In general, how interesting or fun do you find working on assignments in science class?**



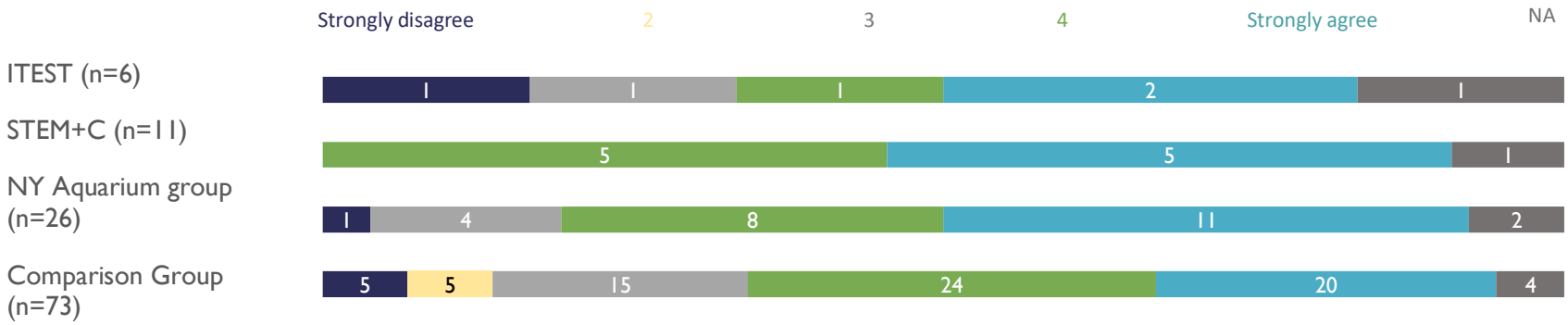
7. **Compared to most of your other activities, how useful is your learning in science class?**



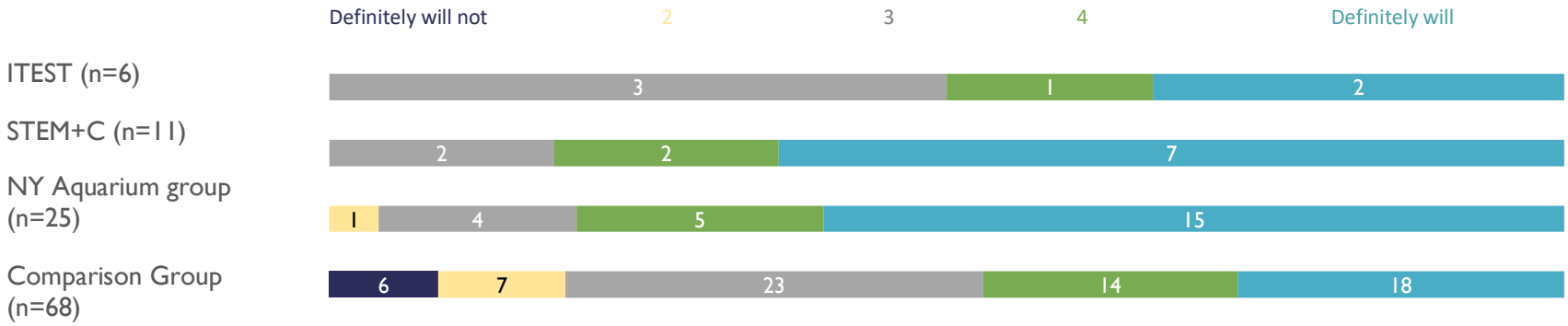
8. **Please indicate how much you agree or disagree with the following statements. I have a sense of belonging to a community of scientists.**



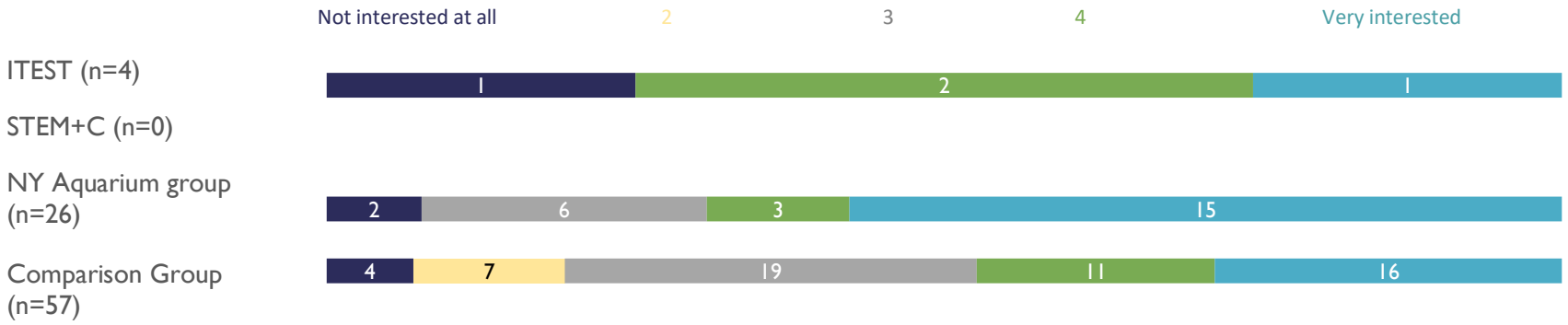
9. **Please indicate how much you agree or disagree with the following statements. I find it personally satisfying to work on a team that is doing research.**



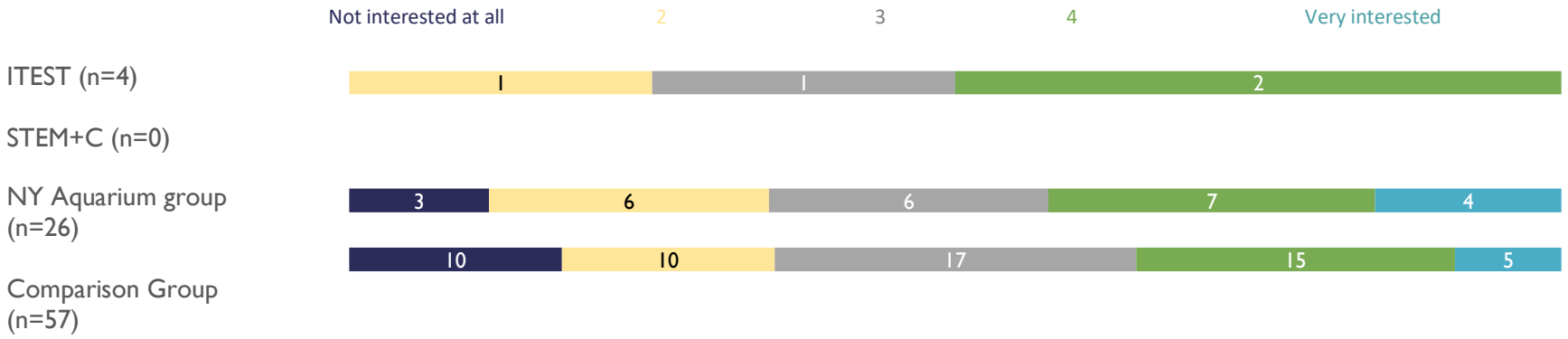
10. **To what extent do you intend to pursue a career in science, technology, or engineering?**



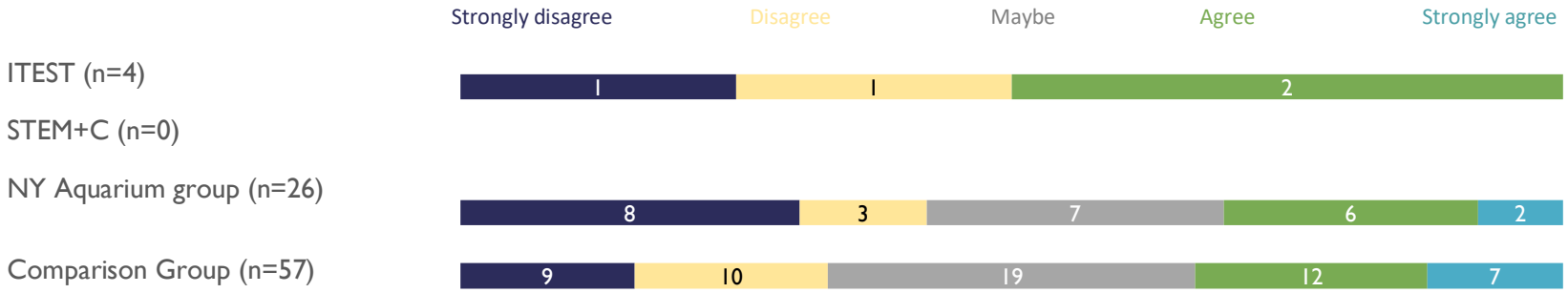
11. How interested are you in jobs related to science?



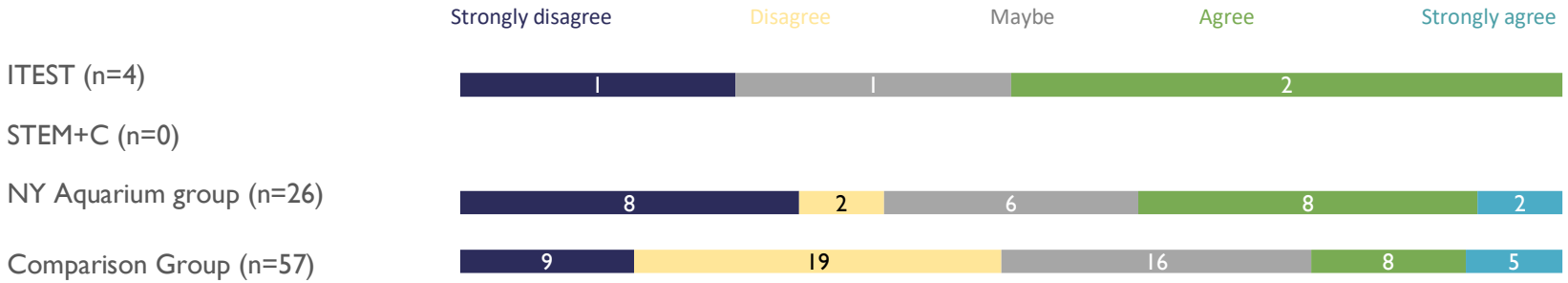
12. How interested are you in jobs related to technology?



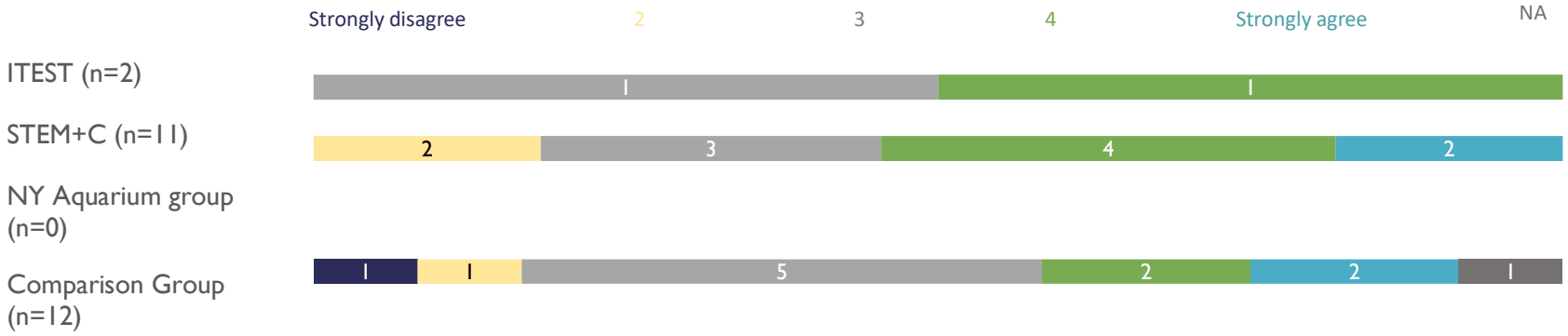
13. How interested are you in jobs related to engineering?



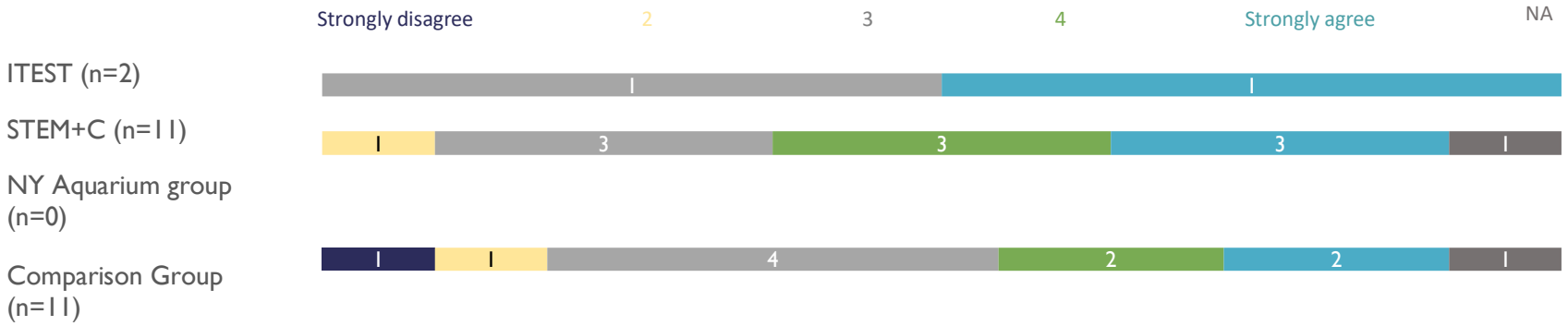
14. How interested are you in jobs related to mathematics?



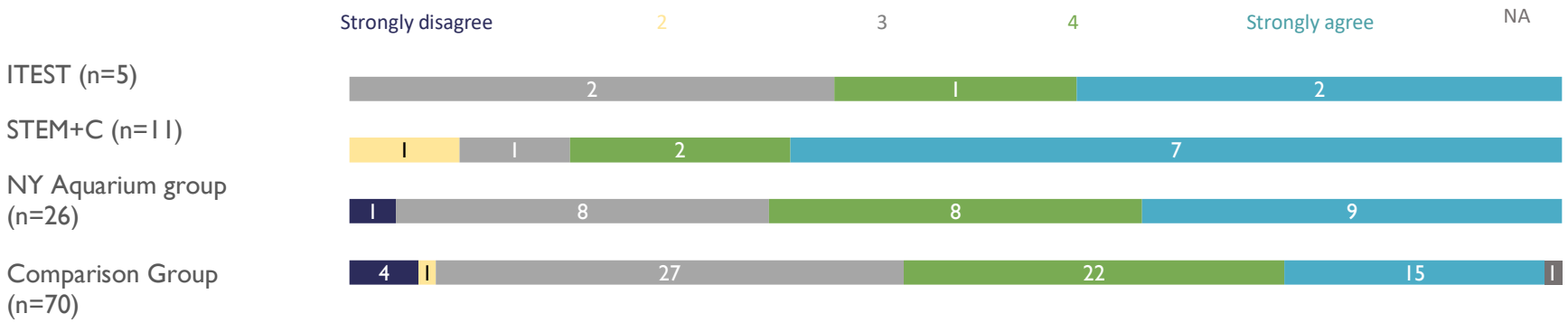
15. Having a career in science would be challenging.



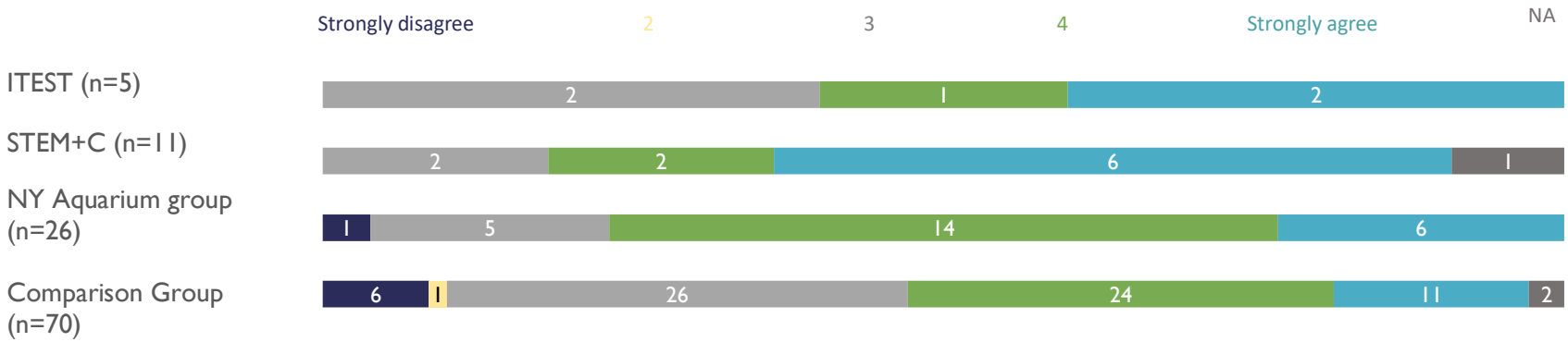
16. My family has encouraged me to study science.



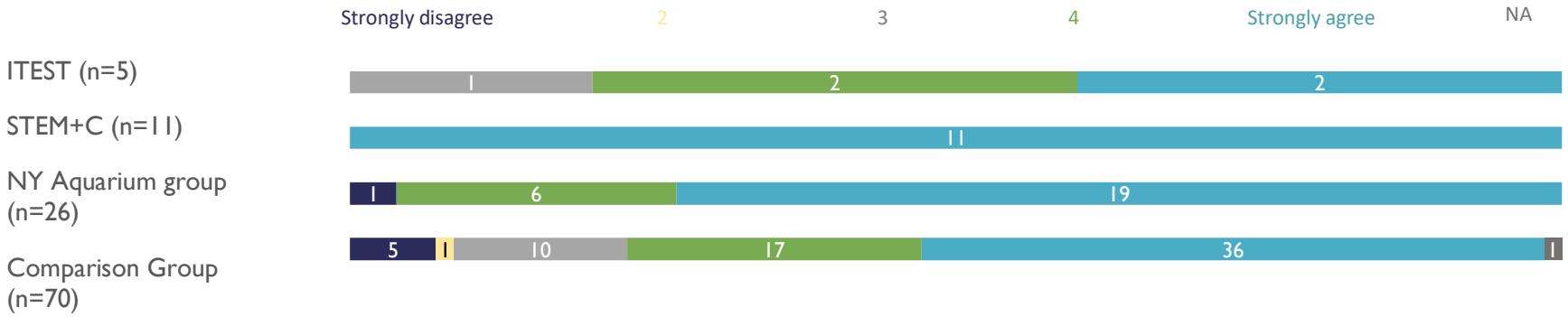
17. I am interested in learning more about possible careers in environmental science.



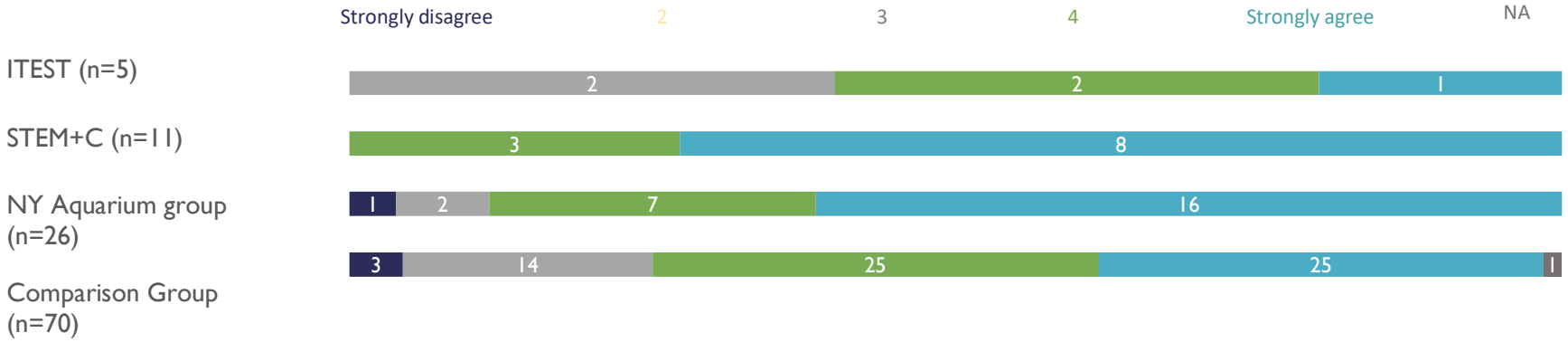
18. Some day when I tell others about my career, they will respect me for doing scientific work.



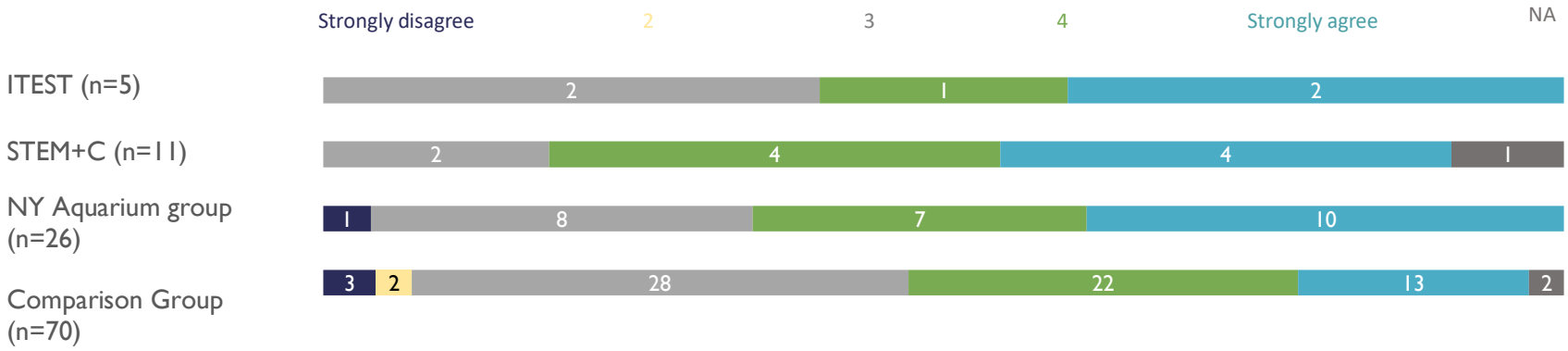
19. Scientists make a meaningful difference in the world.



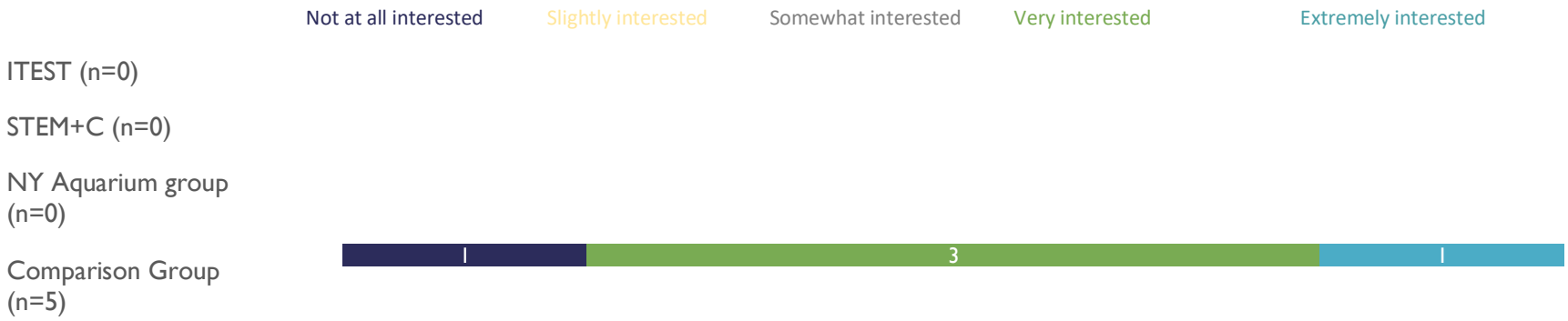
20. A career in science would enable me to work with others in meaningful ways.



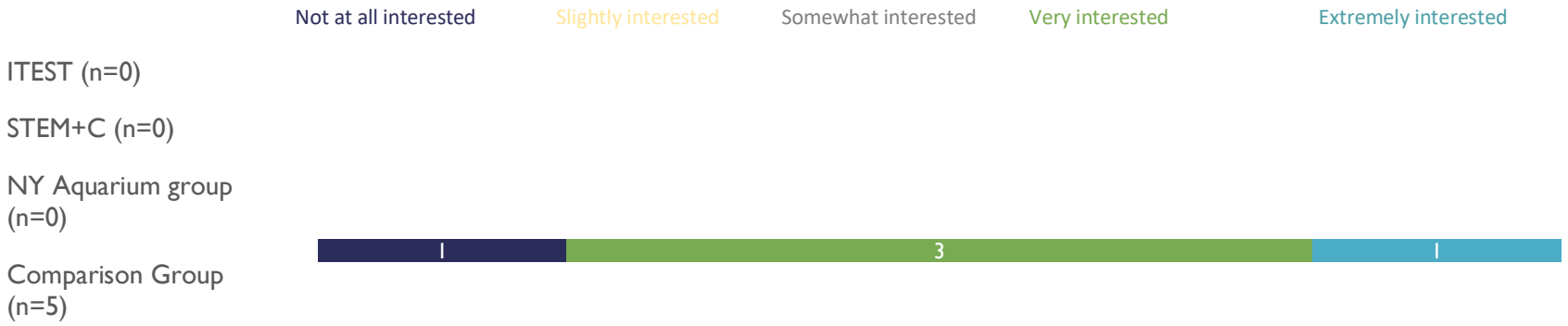
21. I will have a successful professional career and make substantial scientific contributions.



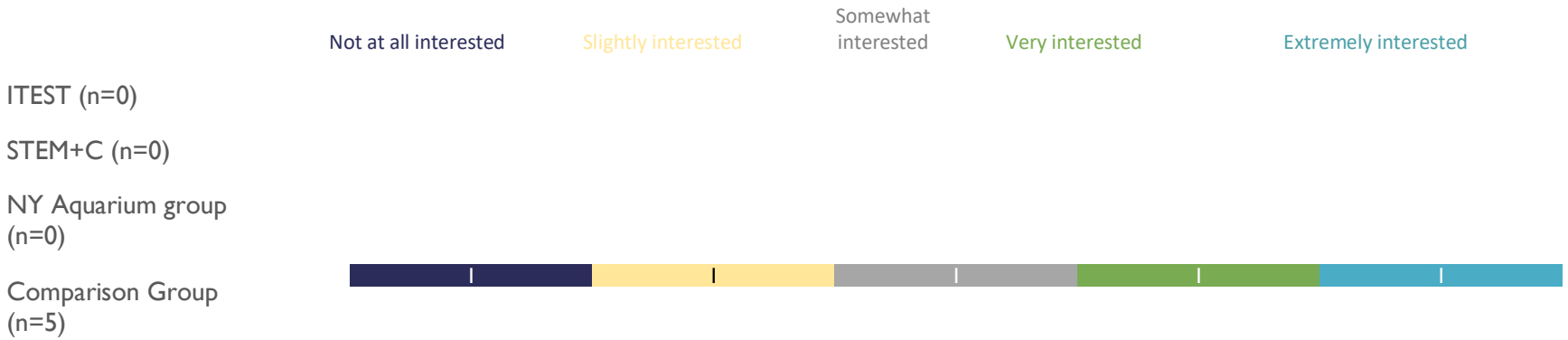
22. How interested are you in jobs related to science?



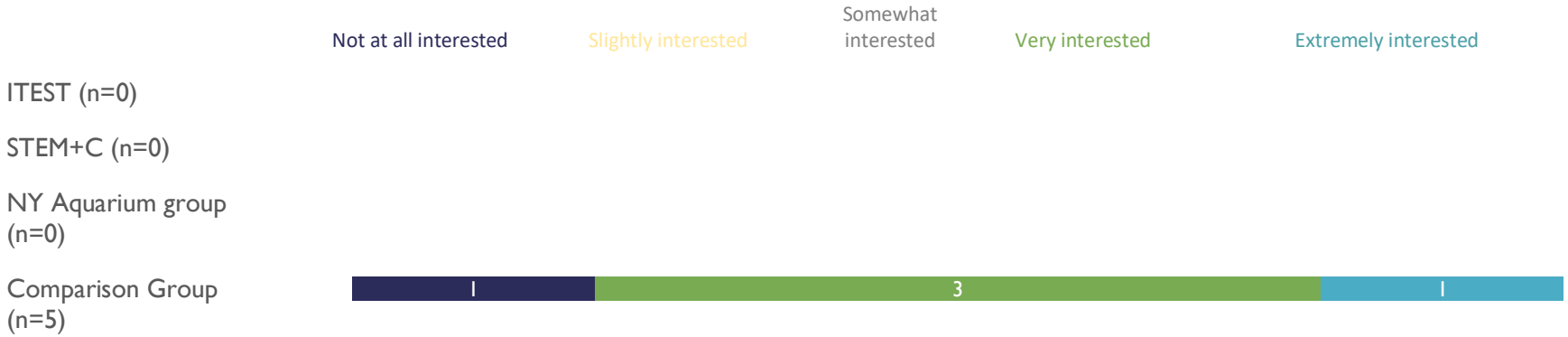
23. How interested are you in jobs related to technology?



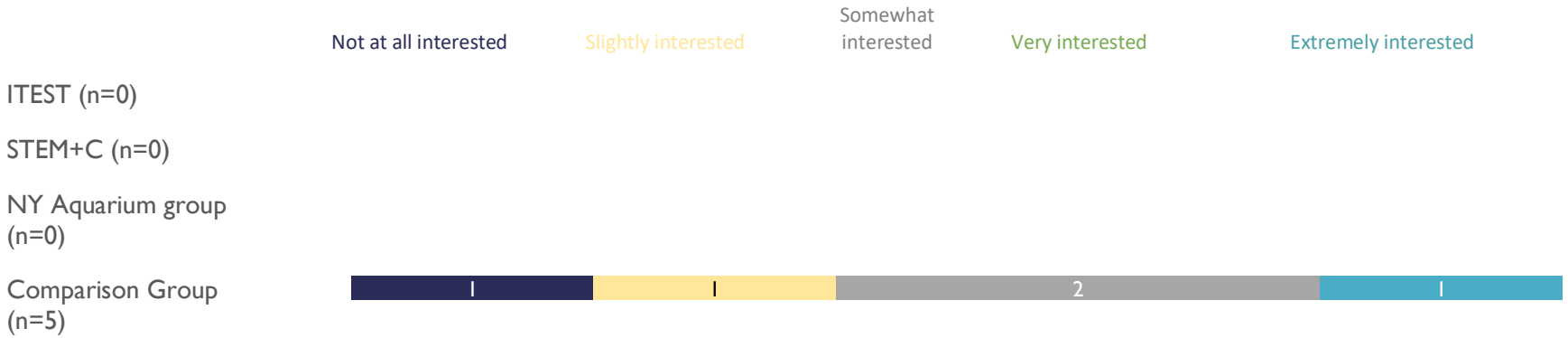
24. How interested are you in jobs related to engineering?



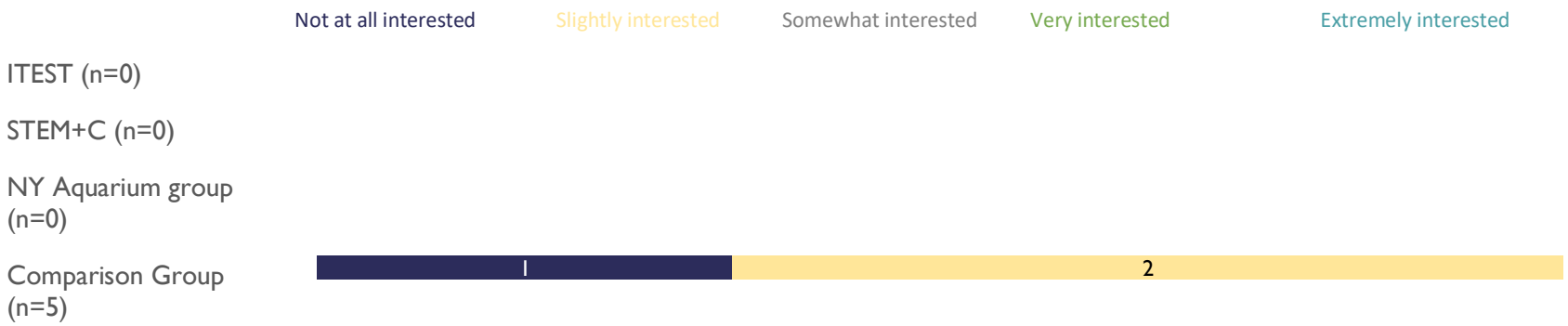
25. How interested are you in jobs related to mathematics?



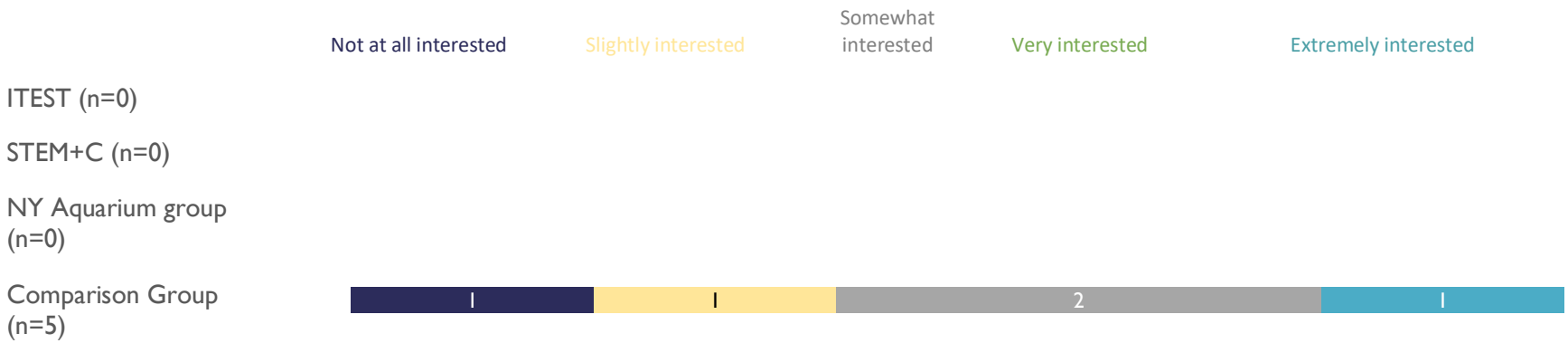
26. Please rate your interest in the following items on a scale of 1 to 5. These jobs listed below are ones that you can get with a community college certificate or associates degree.



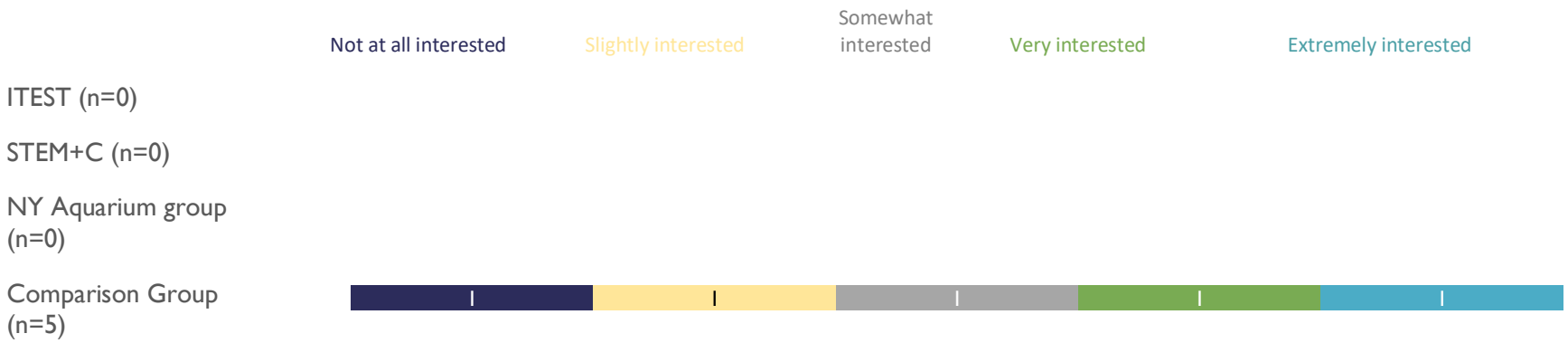
27. Please rate your interest in the following items on a scale of 1 to 5. These jobs listed below are ones that you can get with a community college certificate or associates degree.



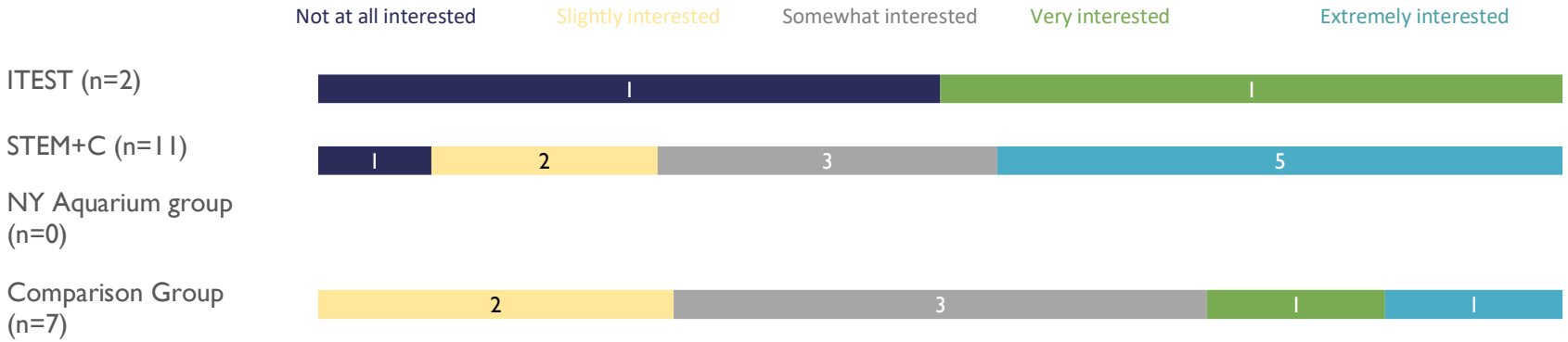
28. Please rate your interest in the following items on a scale of 1 to 5. These jobs listed below are ones that you can get with a community college certificate or associates degree.



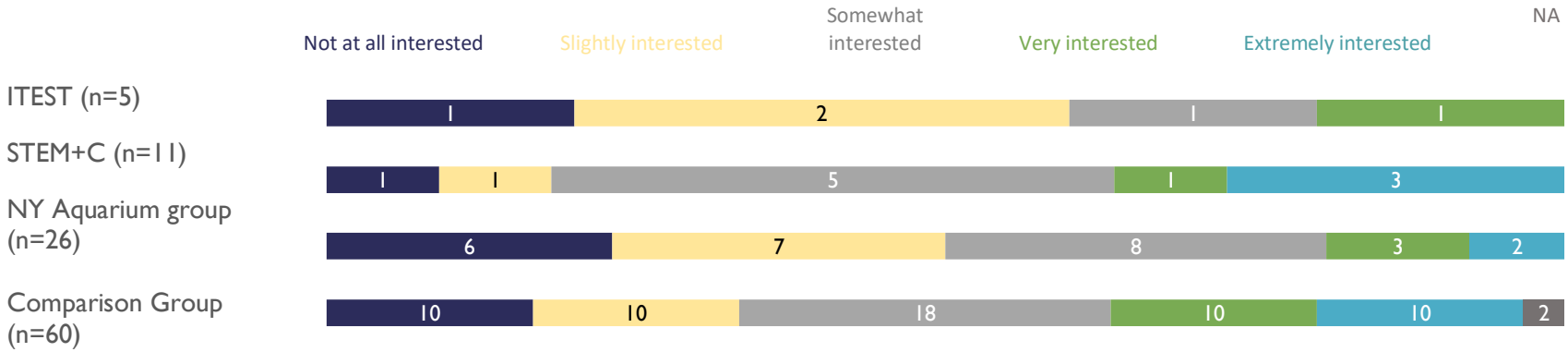
29. Please rate your interest in the following items on a scale of 1 to 5. These jobs listed below are ones that you can get with a community college certificate or associates degree.



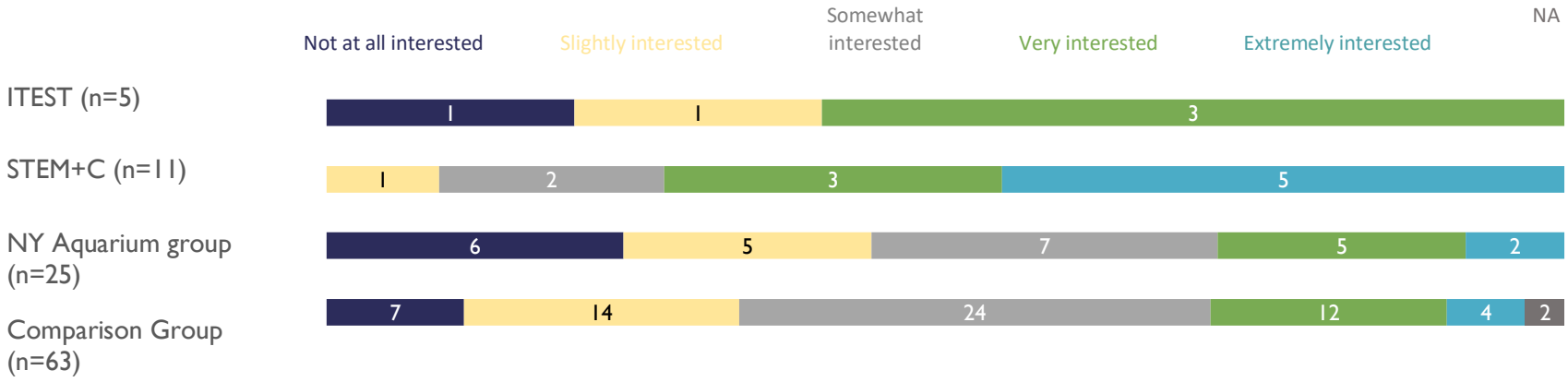
30. Please rate your interest in the following items on a scale of 1 to 5. These jobs listed below are ones that you can get with a community college certificate or associate degree Wastewater Engineer- Conduct technical studies, computer modeling, technical"&" report writing, design and provide construction service support for wastewater projects.



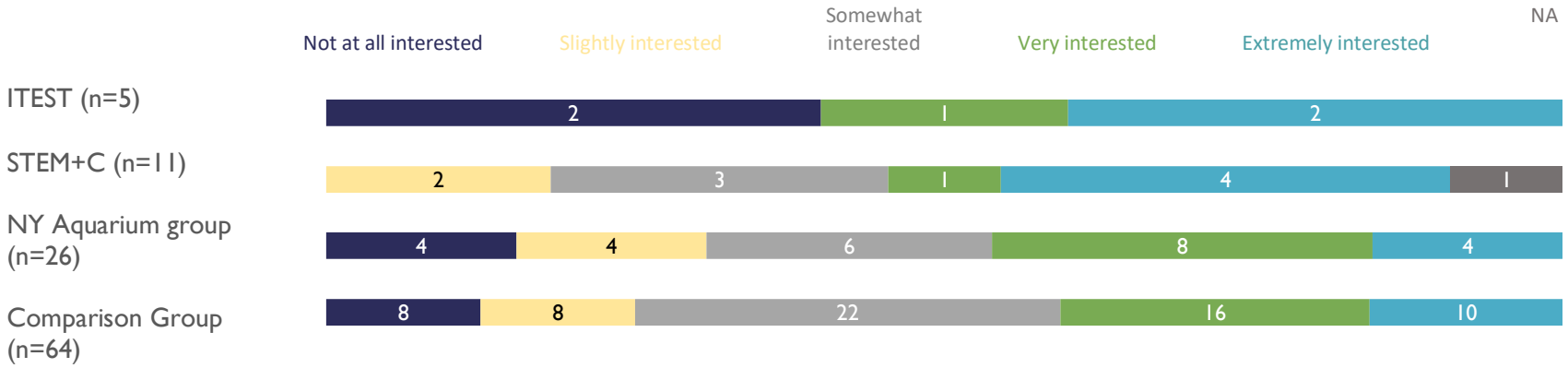
31. **Please rate your interest in the following items on a scale of 1 to 5. These jobs listed below are ones that you can get with a community college certificate or associate degree. Marine System Technician- Equipment installation and repair, metal fabrication, carpentry, rigging, painting.**



32. **Please rate your interest in the following items on a scale of 1 to 5. These jobs listed below are ones that you can get with a community college certificate or associate degree. Hydrologist- Study water movement, and mitigate issues related to water quality and availability.**



33. **Please rate your interest in the following items on a scale of 1 to 5. These jobs listed below are ones that you can get with a community college certificate or associate degree. Biological Technician-set up and clean laboratory equipment, collect biological samples in lab, execute experiments and tests, document test results and compose reports of findings.**



34. **Have you participated in any of the following extracurricular activities in the last 12 months involving: ?**

	Participant group	Yes	No	No change from when I took the pre-survey
Coding	Comparison Group - general link (n=37)	11	26	
	Comparison Group - NY Aquarium			
	ITEST (Ph2) (n=3)	2	1	
	STEM+C (Ph3)			

	Participant group	Yes	No	No change from when I took the pre-survey
Astronomy	Comparison Group - general link (n=37)	4	33	
	Comparison Group - NY Aquarium			
	ITEST (Ph2) (n=3)	1	2	
	STEM+C (Ph3)			

	Participant group	Yes	No	No change from when I took the pre-survey
Using Excel or Google Sheets for statistics	Comparison Group - general link (n=37)	13	24	
	Comparison Group - NY Aquarium			
	ITEST (Ph2) (n=3)	1	2	
	STEM+C (Ph3)			

	Participant group	Yes	No	No change from when I took the pre-survey
Robotics or Engineering	Comparison Group - general link (n=37)	12	25	
	Comparison Group - NY Aquarium			
	ITEST (Ph2) (n=2)		2	
	STEM+C (Ph3)			

	Participant group	Yes	No	No change from when I took the pre-survey
Science fairs or tournaments	Comparison Group - general link (n=37)	12	25	
	Comparison Group - NY Aquarium			
	ITEST (Ph2) (n=2)		2	
	STEM+C (Ph3)			

	Participant group	Yes	No	No change from when I took the pre-survey
Other STEM or Computing activities	Comparison Group - general link (n=37)	15	22	
	Comparison Group - NY Aquarium			
	ITEST (Ph2) (n=2)	1	1	
	STEM+C (Ph3)			

35. Have you participated in:

	Participant group	Yes	No	No change from when I took the pre-survey
Interned in STEM field	Comparison Group - general link (n=70)	13	57	
	Comparison Group - NY Aquarium (n=26)	14	12	
	ITEST (Ph2) (n=5)	1	4	
	STEM+C (Ph3) (n=11)	1	10	

	Participant group	Yes	No	No change from when I took the pre-survey
Worked in STEM field	Comparison Group - general link (n=2)	1	1	
	Comparison Group - NY Aquarium			
	ITEST (Ph2)			
	STEM+C (Ph3)			

	Participant group	Yes	No	No change from when I took the pre-survey
Volunteered in STEM field	Comparison Group - general link (n=58)	7	39	12
	Comparison Group - NY Aquarium (n=26)	20	4	2
	ITEST (Ph2) (n=4)	2	2	
	STEM+C (Ph3)			

	Participant group	Yes	No	No change from when I took the pre-survey
Volunteered in a field related to environmental cleanup and restoration, including environmental activism	Comparison Group - general link (n=58)	13	38	7
	Comparison Group - NY Aquarium (n=26)	17	6	3
	ITEST (Ph2) (n=4)	2	2	
	STEM+C (Ph3)			

	Participant group	Yes	No	No change from when I took the pre-survey
Job shadowed in STEM field in past 4 years	Comparison Group - general link (n=70)	12	58	
	Comparison Group - NY Aquarium (n=26)	3	23	
	ITEST (Ph2) (n=5)		5	
	STEM+C (Ph3) (n=11)		11	

	Participant group	Yes	No
Web Design	Comparison Group - general link (n=2)	1	1
	Comparison Group - NY Aquarium (n=0)		
	ITEST (Ph2) (n=0)		
	STEM+C (Ph3) (n=0)		

36. **Please write the title of the people who you job shadowed in a STEM field:** Math teacher.
37. **Please write the names of the organizations where you volunteered in a science, technology, engineering and/or math field.**

Organization	Comparison Group - general link	Comparison Group - NY Aquarium	ITEST (Ph2)	STEM+C (Ph3)	
					Frequency/Amount of time
None				1	
NY Harbor Seals civic science.				1	
Queens Zoo				1	
Billion Oyster Project				1	4 weeks/throughout the school year in 9th Grade
Boy Scouts, Camp Buckskin at Camp Reed				1	1 week
Coney Island Beach Cleanup				1	82
Key Club for beach cleanup, Recycling club				1	have done this since freshmen year
Sunnyside garden park cleanup, earth day park cleanup. most of the environmental cleanups I have done have been independent , things like going to the beach with the intention of picking up trash, but I have not worked with a high profile cleanup initiative yet.				1	N/A

38. **Are there family members who provide you with guidance on preparing for a job in science?**

Family members' Guidance	Participant group	Yes	No
	Comparison Group - general link (n=69)	32	37
	Comparison Group - NY Aquarium (n=26)	4	22
	ITEST (Ph2) (n=5)	3	2
	STEM+C (Ph3) (n=11)	5	6

39. **Number of family members who provide you with guidance on preparing for a job in science:**

	Frequencies			
Number of family members providing guidance	Comparison Group - general link	Comparison Group - NY Aquarium	ITEST (Ph2)	STEM+C (Ph3)

1	1			2
2	1			1
3				2
Total	**2**			**5**

40. Are there mentors outside of your home who provide guidance on preparing for a job in science?

Outside Mentors' Guidance	Participant group	Yes	No
	Comparison Group - general link (n=69)	26	43
	Comparison Group - NY Aquarium (n=26)	16	10
	ITEST (Ph2) (n=5)	2	3
	STEM+C (Ph3) (n=11)	8	3

41. Number of mentors outside of your home who provide you with guidance on preparing for a job in science:

	Frequencies			
Number of family members providing guidance	Comparison Group - general link	Comparison Group - NY Aquarium	ITEST (Ph2)	STEM+C (Ph3)
0				1
1	1			1
2	1			4
3	1			1
Total	**3**			**7**

42. **This question is about your experience participating in corresponding activities. Please answer by typing a number in the following textboxes. Please type in a period (".") if you don't want to answer a question.**

	Frequencies			
Number of science fairs or tournaments participated in the last 12 months	Comparison Group - general link	Comparison Group - NY Aquarium	ITEST (Ph2)	STEM+C (Ph3)
0	5	3		
1	11	4		
2	2			1
3			1	
4		1		
Total	**18**	**8**	**1**	**1**

	Frequencies			
Number of awards received at science fairs or tournaments in the last 12 months	Comparison Group - general link	Comparison Group - NY Aquarium	ITEST (Ph2)	STEM+C (Ph3)
0	5			1
1	5			
2	3			
5	1			
Total	**14**			**1**

	Frequencies			
Number of extracurricular activities involving computer coding in the last 12 months	Comparison Group - general link	Comparison Group - NY Aquarium	ITEST (Ph2)	STEM+C (Ph3)
0	2			
1	4			2
2	2			1
3	2			
5	3			1
Total	**13**			**4**

	Frequencies			
Number of extracurricular activities involving robotics or engineering in the last 12 months	Comparison Group - general link	Comparison Group - NY Aquarium	ITEST (Ph2)	STEM+C (Ph3)
0	17	16	1	
1	5	1		
2	1	2		1
4			1	1
5	1			
6	1			
Total	**25**	**19**	**2**	**2**

	Frequencies			
Number of extracurricular activities involving astronomy in the last 12 months	Comparison Group - general link	Comparison Group - NY Aquarium	ITEST (Ph2)	STEM+C (Ph3)
0	21	20	2	
1	2			1
2	2			
7	1			
Total	**26**	**20**	**2**	**1**

	Frequencies			
Number of extracurricular activities involving using Excel or Google Sheets for statistics in the last 12 months	Comparison Group - general link	Comparison Group - NY Aquarium	ITEST (Ph2)	STEM+C (Ph3)
0	3			
1	3			
2	3		1	2
3				1
5				1
9	1			
10	1			
Total	**11**		**1**	**4**

Science Engagement

1. **Have you attended any presentations where a scientist presented?**

	Participant group	Yes	No
Scientist presentations	Comparison Group - general link (n=2) Comparison Group - NY Aquarium (n=0) ITEST (Ph2) (n=0) STEM+C (Ph3) (n=0)	2	

2. **How would you rate your level of engagement with scientists in general?**

	Frequencies			
Level of Engagement	Comparison Group - general link	Comparison Group - NY Aquarium	ITEST (Ph2)	STEM+C (Ph3)
1	11	3	1	
2	12	5	1	2
3	23	10	2	3
4	13	5	1	4
5	7	3		1
Total	**66**	**26**	**5**	**10**

3. **Received direct guidance on projects from a scientist:**

	Participant group	Yes	No	No change from when I took the pre-survey
Direct guidance from scientist	Comparison Group - general link (n=66) Comparison Group - NY Aquarium (n=26) ITEST (Ph2) (n=5) STEM+C (Ph3) (n=10)	15 8 1 2	51 18 4 8	

4. **Watched videos made by scientists (For example, YouTubers Veritassium, Mark Rober, Smarter Every Day)**

	Participant group	Yes	No	No change from when I took the pre-survey
Watched videos by scientist	Comparison Group - general link (n=66)	48	18	
	Comparison Group - NY Aquarium (n=26)	23	3	
	ITEST (Ph2) (n=5)	5		
	STEM+C (Ph3) (n=10)	8	2	

5. **Attended any talks where a scientist spoke:**

	Participant group	Yes	No	No change from when I took the pre-survey
Attended talks	Comparison Group - general link (n=61)	12	49	
	Comparison Group - NY Aquarium (n=26)	18	8	
	ITEST (Ph2) (n=4)	2	2	
	STEM+C (Ph3) (n=0)			

6. **Read articles written by scientists:**

	Participant group	Yes	No	No change from when I took the pre-survey
Read articles	Comparison Group - general link (n=66)	44	22	
	Comparison Group - NY Aquarium (n=26)	24	2	
	ITEST (Ph2) (n=5)	5		
	STEM+C (Ph3) (n=10)	7	3	

7. **Listen to podcasts by scientists:**

	Participant group	Yes	No	No change from when I took the pre-survey
Podcasts	Comparison Group - general link (n=66)	16	50	
	Comparison Group - NY Aquarium (n=26)	8	18	
	ITEST (Ph2) (n=5)		5	
	STEM+C (Ph3) (n=10)	1	9	

8. **Do you have family members who are scientists?**

	Participant group	Yes	No	No change from when I took the pre-survey
Family member scientists	Comparison Group - general link (n=11)	3	8	
	Comparison Group - NY Aquarium (n=0)			
	ITEST (Ph2) (n=2)	1	1	
	STEM+C (Ph3) (n=10)	2	8	

9. **Do you or your family have acquaintances who are scientists? *Note: an acquaintance is a person you know who doesn't have to be a friend. For example, a neighbor can be an acquaintance.**

	Participant group	Yes	No	No change from when I took the pre-survey
Acquaintances who are scientists	Comparison Group - general link (n=66)	23	43	
	Comparison Group - NY Aquarium (n=26)	3	23	
	ITEST (Ph2) (n=5)	5		
	STEM+C (Ph3) (n=10)	6	4	

10. **How many projects have you participated in where you received direct guidance from a scientist in the last 12 months?**

	Frequencies			
Number of projects	Comparison Group - general link	Comparison Group - NY Aquarium	ITEST (Ph2)	STEM+C (Ph3)
0	1			
2	2			
5				5
Total	**3**			**2**

11. **How many videos made by scientists do you watch in an average month?**

	Frequencies			
Number of projects	Comparison Group - general link	Comparison Group - NY Aquarium	ITEST (Ph2)	STEM+C (Ph3)
0	1	1		
1	4	1		
2	6	1		1
3	7	5		
4	4	3	1	
5	5	1		2
6	1			
8	1	3		
10	4	4	2	1
12	1			
13		1		
15	3		1	
20	3	1		2
25	1			
60		1		1
125				1

12. **How many articles written by scientists do you read in an average month?**

	Frequencies			
Number of Articles	Comparison Group - general link	Comparison Group - general link	Comparison Group - general link	Comparison Group - general link
0	2		1	
1	4	1		
2	5	3	1	
3	1			2
4	1	1		
5	6	1	1	

7	1			1
8	1	1		1
10	1			3
13	1			
15		1		
20				1
23	1			
30		1		
60				1
120		1		
Grand Total	24	10	3	9

13. How many podcasts led by scientists do you listen to in an average month?

Number of podcasts	Frequencies			
	Comparison Group - general link	Comparison Group - NY Aquarium	ITEST (Ph2)	STEM+C (Ph3)
0			1	
1	3		1	
2		1		
3		1		
5	1	2		1
6	1			
Grand Total	5	4	2	1

14. How many of your family members or close friends are scientists?

Number of family/friends Who are scientists	Frequencies			
	Comparison Group - general link	Comparison Group - NY Aquarium	ITEST (Ph2)	STEM+C (Ph3)
0			1	
1	2			1
3				1
Grand Total	2		1	2

15. **How many of your acquaintances are scientists?**

Number of acquaintances	Frequencies			
	Comparison Group - general link	Comparison Group - NY Aquarium	ITEST (Ph2)	STEM+C (Ph3)
0	1		1	
1	3			2
2				2
3				3
5	2			
6			1	
Grand Total	6		2	7

16. **How many presentations have you attended where a scientist presented?**

Number of presentations	Frequencies			
	Comparison Group - general link	Comparison Group - NY Aquarium	ITEST (Ph2)	STEM+C (Ph3)
1	1			
Grand Total	1			

17. **Have you attended any events where a scientist presented or spoke?**

	Participant group	Yes	No	No change from when I took the pre-survey
Attended events	Comparison Group - general link (n=6)	4	2	
	Comparison Group - NY Aquarium (n=0)			
	ITEST (Ph2) (n=1)		1	
	STEM+C (Ph3) (n=10)	7	3	

18. **How many events have you attended where a scientist presented or spoke in the last year?**

Number of events attended	Frequencies			
	Comparison Group - general link	Comparison Group - NY Aquarium	ITEST (Ph2)	STEM+C (Ph3)
1	2			1
2	1			2
4				1
5				1
6				1
9				1
15	1			
Grand Total	4			7

Digital Platform

1. **Have you used the BOP digital platform?** [used_digital_platform.participation.ph3]

Participant group	Yes	No	I don't Know	Other
Comparison Group - general link (n=2) Comparison Group - NY Aquarium ITEST (Ph2) STEM+C (Ph3)			1	

2. **Your feedback will help us support you and improve the program. Please select the answer that best expresses your opinion. I am confident I can navigate the STEM-CCE digital platform.** [ph3.F.STEM+C_platform.Navigate:F.STEM+C_platform]

No responses.

3. **Your feedback will help us support you and improve the program. Please select the answer that best expresses your opinion. I find the digital platform easy to use.** [ph3.F.STEM+C_platform.Easy_to_use:F.STEM+C_platform]

No responses.

Preparation to pursue STEM careers

1. **Please select the answer below that tells us which devices you use in school or in your life outside of school:** All responses are for (Multiple times a day)
   Ph3. Preparation to Pursue STEM Careers. Access_to_technology…(1= Less than once a month, 2=once a month, 3=once a week, 4=once a day to 5=Multiple times a day)

	ITEST (Ph2)	STEM+C (Ph3)	Comparison Group - general link	Comparison Group - NY Aquarium
I have access to a smartphone	Multiple times/day =1	--	--	--
I have access to a tablet that I can use at home.	Multiple times/day =1	--	--	--
I have access to a computer that I can use at home.	Multiple times/day =1	--	--	--

Demographics

1. **What grade are you in? (If you are in between, please select the grade you were in most recently)**

	Frequencies			
Grade	Comparison Group - general link	Comparison Group - NY Aquarium	ITEST (Ph2)	STEM+C (Ph3)
10th	7	1	1	1
11th	6	6		4
12th	6	2		4
6th	6	3		
7th	2	1		
8th	2	3		
9th	20	1	4	1
Grand Total	**49**	**17**	**5**	**10**

2. **With which gender do you most closely identify?**

Gender	Frequencies			
	Comparison Group - general link	Comparison Group - NY Aquarium	ITEST (Ph2)	STEM+C (Ph3)
Do not wish to specify	2	2		
Female	26	9	4	6
Male	23	6	1	3
Grand Total	**51**	**17**	**5**	**9**

3. **With which ethnicity do you most closely identify?**

Ethnicity	Frequencies			
	Comparison Group - general link	Comparison Group - NY Aquarium	ITEST (Ph2)	STEM+C (Ph3)
American Indian or Alaska Native	2		1	
Asian	9	3		4
Black or African American	9	3	1	2
Hispanic/Latino	11	4	1	2
Other - Please specify	4	2		
Pacific Islander or Native Hawaiian	2			
White (non-Hispanic or Latino)	14	5	2	2
Other – South Asian & South American	2			
Other – White & Latino		1		
Other – White & Hispanic	1			
Grand Total	**54**	**18**	**5**	**10**

4. **Will you be the first-generation college student if you attend college in the future?**

Participant group	Yes	No	I'm not sure
Comparison Group - general link (n=51)	13	27	11

Comparison Group - NY Aquarium (n=17)	4	11	2	
ITEST (Ph2) (n=5)	1	3	1	
STEM+C (Ph3) (n=10)	3	7		

Feedback

1. **Would you like to give us feedback about this survey?**

Survey feedback	Frequencies			
	Comparison Group - general link	Comparison Group - NY Aquarium	ITEST (Ph2)	STEM+C (Ph3)
No.	17	8	2	
No. Seriously. I'm done.	20	6	2	
Yes, I'd like to give you feedback!	8	3		
Grand Total	45	17	4	

2. **I hated taking this survey| I loved taking this survey:**

Survey feedback (semantic differential)	Frequencies			
	Comparison Group - general link	Comparison Group - NY Aquarium	ITEST (Ph2)	STEM+C (Ph3)
-2	1	2		1
-1		1		
0	5			
1	4			
2	1	2		
Grand Total	11	5		1

3. **This survey was worse than most surveys I've taken| This survey was better than most survey's I've taken:**

Survey feedback (semantic differential)	Frequencies			
	Comparison Group - general link	Comparison Group - NY Aquarium	ITEST (Ph2)	STEM+C (Ph3)
-2		1		
-1	1	1	1	
0	5			
1	5	1		
2		2		
Grand Total	11	5	1	

4. **Because of this survey, I am less interested in STEM careers| Because I took this survey I am more interested in STEM careers:**

Survey feedback (semantic differential)	Frequencies			
	Comparison Group - general link	Comparison Group - NY Aquarium	ITEST (Ph2)	STEM+C (Ph3)
-2	1		1	
-1	2	1		
0	4			
1	3	1		
2	1	3		
Grand Total	11	5	1	

5. **The text box below is for any final comments, suggestions, or complaints related to this survey that you would like to share with us.**

Survey feedback	Frequencies			
	Comparison Group - general link	Comparison Group - NY Aquarium	ITEST (Ph2)	STEM+C (Ph3)
bbb			1	
does Bill Nye count as a scientist?	1			
I thought the survey was fine. I feel somewhat bad though because I haven't been involved in the field but I want to know more about it.	1			
none	1			
Some of the questions we not fair	1			
This was rly cool :))	1			
Grand Total	5		1	

6. **Time on Survey:**

Total survey time	Frequencies			
	Comparison Group - general link	Comparison Group - NY Aquarium	ITEST (Ph2)	STEM+C (Ph3)
29		2		
54		1		
66	1			
72	1			
79	1			
83	1			
109	1			
137		1		
168	1			
201		1		
207	1			
225		1		
238		1		
242	1			
291		1		

297		I	
315	I		
318	I		
331	I		
332	I		
338		I	
360	I		
369		I	
377			I
382	I		
388	I		
412			I
413	I		
417		I	
420	I		
432	I		
436	I		
438	I		
456	I		
479	I		
498	I		
499	I		
536		I	
557		I	
564	I		
569	I		
579	I		
593			I
616	I		
635	I		
642	I		
647	I	I	
670	I		
705	I		
728	I		

804	1		
912	1		
972	1		
1020	1		
1027	1		
1084	1		
1141		1	
1157	1		
1313		1	
2425	1		
6507	1		
8624	1		
329312	1		
Grand Total	45	17	3