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Report of the Evaluation of the
BOP CCRES ITEST Project
Year 4
2021

Submitted by

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ACCOMPLISHMENTS

I. INTRODUCTION
MAJOR ACTIVITIES

The ITEST Billion Oyster Project (BOP) was designed to carry forward the work of the BOP CCRES Phase I grant conducted from 2014 to 2018 and, in addition, integrate computer and data science into oyster restoration research in the New York Harbor. *The ITEST Billion Oyster Project CCRES (BOP) is comprised of four pillars of activities. Pillar 1: STEM Hubs, oyster restoration research sites and community reefs located in the New York Harbor which provide opportunities for student research; Pillar 2: Near-Peer Mentoring to engage high school juniors as mentors and freshmen as mentees in the Harbor Corps at The Harbor school to explore oyster restoration research and raise awareness of STEM careers in marine and environmental sciences; Pillar 3: Career and Technical Education Professional Learning for Teachers in oyster restoration content and research skills for students; and Pillar 4: Advanced Research Methods for teachers to support students who choose to pursue oyster-related research at a higher, more advanced level in the laboratory.*

The BOP-CCRES digital platform was not operative in 2020-21. Staff worked with Morgan Stanley pro bono consultants to re-work the digital platform and it is projected to be up and running in September 2021. Data collected and posted in CCRES Phase I, the first version of the digital platform, was used consistently throughout the project in Year 4 to facilitate teacher and student learning about oyster restoration in the New York Harbor

MAJOR GOALS
The major goals of the ITEST project are:
- sustain and augment the success of the BOP-CCRES Phase I project
- develop and expand programmatic offerings that increase student engagement and learning in oyster restoration research
- promote student awareness and interest in pursuing STEM careers

- further develop the BOP-CCERS Digital Platform

In Year 4, the lockdown of New York City schools from January to June 2021 had an impact on the implementation of ITEST activities in all four pillars. The following report summarizes the strengths, challenges, and modifications in adapting implementation to the remote learning environment, and then gradually opening up the program to in-person events from September to December 2021 to achieve the project's objectives.

II. EVALUATION METHODOLOGY

Specific Objectives

To gather data to evaluate the extent to which the ITEST program achieved its goals in Year 4, evaluators addressed four key questions in this report to assess the effectiveness of BOP-CCRES in achieving the objectives of: *1) promoting student engagement; and 2) developing student interest in STEM content related to oyster science restoration; and 3) raising student awareness of STEM careers in marine and environmental sciences.*

Evaluation Question 1: How well was the project implemented?

Evaluation Question 2: How well did the project work in supporting teachers and STEM professionals/scientists/ mentors to motivate students in developing interests, skills, knowledge, and career awareness in restoration science and related STEM fields?

Evaluation Question 3: How well did the project work in supporting students to engage in STEM, increase career awareness, and motivate them to pursue STEM interests, skills, and follow formal educational pathways in the New York City public school system.

Evaluation Question 4: To what extent was the research plan effective in identifying the impacts of the program related to: 1) preparing and supporting teachers to teach and facilitate students science research and investigation skills; 2) developing students' knowledge and learning in oyster restoration research; and 3) promoting students' interest in STEM careers.

Evaluation Activities

Evaluators conducted the following evaluation activities from January to December 2021 to evaluate the effectiveness and impact of the ITEST program in Year 4:
- Professional Learning Survey (ongoing)
- Observations of teacher professional learning sessions (ongoing)
- Year-End Retrospective Teacher Survey (June)
- Observations of Symposium Project presentations (June)
- Student Research Survey Evaluation Questions (ongoing)

Student data collection was a challenge in Year 4, but gradually improved throughout the year, researchers successfully gathering more student data than in previous years of the project. In Year 4, in April and August, the student survey was taken offline to streamline the experience for students and make it easier for them to complete the survey and get parent consent. A paper version of the survey was developed as a back-up to use with student in-person events when online survey participation was not achieved. The third iteration of the survey was administered at student events during November 2021. While the goals of the questions remained the same, wording of the questions and answer choices changed. Several evaluation questions were added. These items focused on students' perceptions of their STEM skills in scientific investigation and their awareness of marine-related STEM careers, two of the project's major objectives.

In Fall 2021, evaluators encountered new challenges in collecting teacher survey data. Several challenges in collecting teacher evaluation data were identified: 1) teachers were exhausted by the efforts of virtual teaching for the entire school year due to covid19, and had no bandwidth left to fill out surveys, several of which came at the end of the school year in June 2021 when they were working with students to complete Symposium projects; 2) the master list of teacher participants had not been curated sufficiently to weed out citizen scientists who participate in BOP activities but whose responses are not included in the grant's data analysis; and 3) there is a small, very dedicated and committed cadre of teachers who participated enthusiastically in all BOP activities and completed surveys. These teachers were very satisfied and excited about the project's offerings, both for them and their students as will be demonstrated in the findings presented below. The response to teacher surveys improved in the fourth quarter, once teachers and students returned to school in-person.

III. EVALUATION FINDINGS

Findings from the evaluation activities are summarized below in sections entitled: *Significant Results* and *Key Outcomes*.

SIGNIFICANT RESULTS

Below are presented the statistically significant results from an analysis of the responses to evaluation questions that were included in the Student Research Survey. The questions were specific to student experiences in Pillar 1: STEM Hub activities, and Pillar 2: Near Peer Mentoring activities in April to July 2021. Surveys were made available online to students at the completion of each event.

These significant outcomes provide evidence of the effectiveness of the BOP-CCRES ITEST project in contributing to meeting its objectives to advance students' knowledge and practice of scientific research skills and to raise student awareness of career opportunities in marine science-related fields.

PILLAR 1: STEM HUBS SIGNIFICANT RESULTS
Results of Comparison Group: Student Perceptions of Science Skills, April to July 2021

In STEM Hub activities, students participated in virtual and in-person visits and explorations of oyster restoration stations to collect and analyze data about water quality and oyster mortality. Evaluators compared STEM Hub participant responses to responses from students who completed the survey from April to July 2021, but could not definitively be connected to their participation in a BOP activity. Findings show:
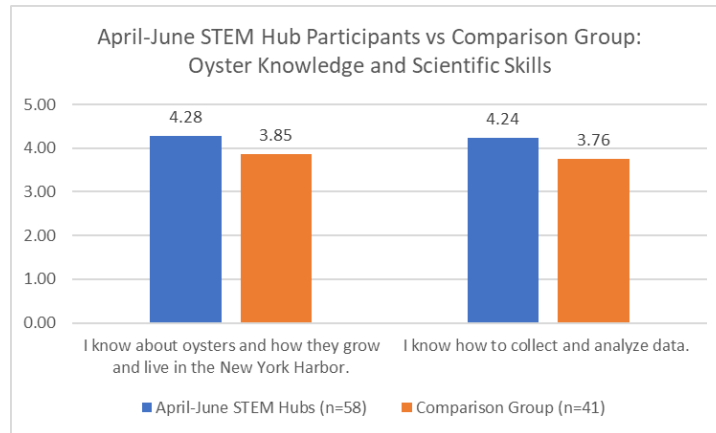
April-June STEM Hub Participants vs Comparison Group: Oyster Knowledge and Scientific Skills

- STEM Hub participants reported knowing more about oysters than the comparison group. The average response was 0.43 higher.
- STEM Hub participants' average response to the statement *I know how to collect and analyze data* was more positive than the comparison group by 0.48 points.
- Unpaired t-tests were performed. These results were statistically significant.

Results of Comparison Group: Student Career Awareness
Findings show:
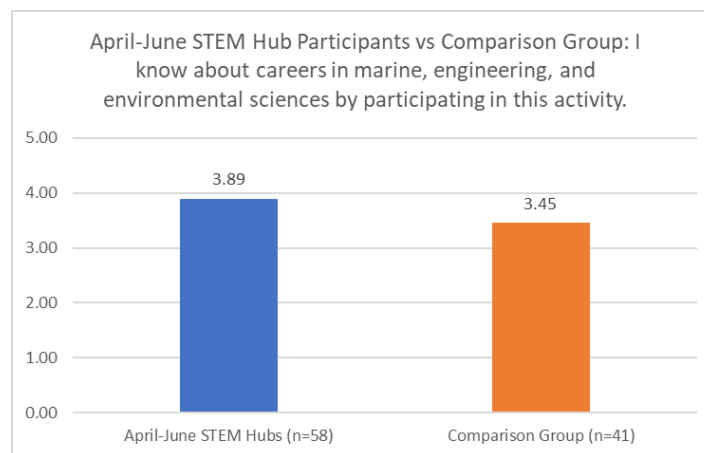
April-June STEM Hub Participants vs Comparison Group: I know about careers in marine, engineering, and environmental sciences by participating in this activity.

- STEM Hub participants reported more marine, engineering, and environmental science career knowledge than the comparison group. The average response was 0.44 points higher.
- Unpaired t-test were conducted on the results for the STEM Hub participants and the control group. The results were statistically significant.

PILLAR 2: NEAR PEER MENTORING SIGNIFICANT RESULTS
Harbor School Near Peer Mentor Participants and Comparison Group, April to June 2021

The Harbor School Near Peer Mentoring program participants' responses to relevant questions were compared with the responses of students who completed a survey but did not attend a BOP event during April-June 2021.
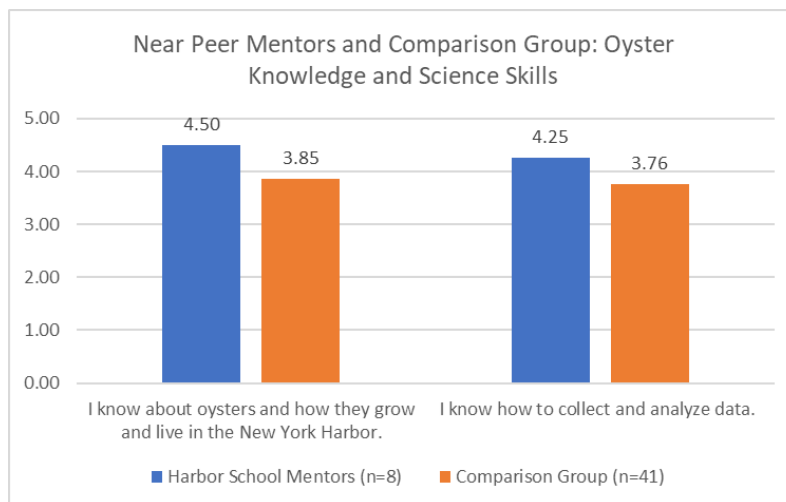
- Harbor School near peer mentors reported higher average responses than students who did not have BOP involvement.
- The average response to *I know about oysters and how they grow and live in New York Harbor* was 0.65 point higher for mentors in the near peer mentoring program.
- The average response to *I know how to collect and analyze data* was 0.49 points higher for mentors.
- Unpaired t-tests were conducted on the mentor and comparison group responses. The results were statistically significant.

KEY OUTCOMES OR OTHER ACHIEVEMENTS, By Evaluation Question

In this section, the report presents key outcomes for each evaluation question (specific objective). *NOTE: All evaluation results can be found in full reports in the Appendix.*

EVALUATION QUESTION 1: *How well was the BOP CCRES ITEST program implemented?*

The BOP CCRES project achieved its objectives in all four pillars to:
- sustain and augment the success of the BOP-CCRES Phase I project
- develop and expand programmatic offerings that increase student engagement and learning in oyster restoration research
- promote student awareness and interest in pursuing STEM careers
- further develop the digital platform as a tool for student data collection and a resource for teachers to use BOP CCRES curriculum

PILLAR 1: STEM HUBS

Pillar 1 was fully implemented throughout the year. STEM Hubs are field research sites located in the New York Harbor that include Coney Island, Brooklyn Bridge Park, Bush Terminal Park, Canarsie, and other sites where the Billion Oyster Project maintains oyster reefs and/or oyster research stations to monitor oyster restoration. Pre-covid, students visited these sites to do research, collecting water quality and oyster mortality data. These experiences were conducted virtually in the classroom in spring 2021 but eased into some in-person sessions in fall 2021.

BOP educators facilitated individual sessions online with a teacher and her middle or elementary level students "in the classroom." Activities included a presentation of the Billion Oyster Project's work to restore oysters, including the history of oysters in the New York Harbor; the life cycle of oysters, a map of locations of oyster reefs at the STEM Hub sites; and oyster research station monitoring and research opportunities for in-person research when the pandemic eases. The educator also presented her pathway to her career as a science educator, the varieties of STEM marine careers, and opportunities to pursue those careers in the Career Technical Education programs at the Harbor School.

PILLAR 2: NEAR-PEER MENTORING

Pillar 2 was more fully implemented as the year progressed. The first component of this pillar is the Career Webinar panel discussions on Zoom to an audience of primarily middle school students. Each panel focused on a specific STEM marine career including: Aquaculture, Marine Biology Research, Marine Systems Technology, Marine Affairs Policy & Advocacy, Ocean Engineering, Professional Diving, and Vessel Operations. Representatives from the relevant disciplines discussed their work, shared how they got interested in the profession, and outlined

the education and preparation they had undergone to qualify for their positions. Every webinar panel included a professional who had graduated from the Harbor High School, as well as current students in the relevant Career and Technical Education (CTE) program at the Harbor School. This element heightened the interest of the audience, most of whom were middle school students thinking about where they wanted to go to high school. These webinars were facilitated by Harbor School student mentors, who introduced the panel of participants, facilitated the presentations, and fielded questions from the students.

A second component of Pillar 2 is the mentoring of Harbor School Grade 9 freshmen by Harbor School juniors in an afterschool program called the Harbor Corps. The mentor and mentee students met once a week to explore topics of relevance to the students in relation to the Harbor School experience and the process of identifying their career aspirations and selecting a career track.

A third Near-Peer Mentoring feature was developed in Spring 2021 between high school student mentors in the Harbor Corps at the Harbor School and Grade 3 and 4 students at PS 676 in Red Hook in Brooklyn to build the younger students' experience of the New York Harbor and introduce them to the marine careers and opportunities at the Harbor School in preparation for them to choose a high school in Grade 5. Marine career activities designed to promote a mentor-mentee relationship between the high school and elementary school students included: a paper boat building project, a boat design project, and a number of sessions about marine creatures. The Harbor Corps students also talked to the younger students several of the six career choices at the Harbor School: marine biology, diving, and welding. The fall sessions started with another 'design-build' project: a model of a floating wetlands made with craft sticks, wine corks and tape. These mentoring sessions with elementary students began in late spring 2021 and continued from September to December 2021. The middle school students were not asked to respond to the Student Research Survey.

PILLAR 3: CAREER AND TECHNICAL EDUCATION PROFESSIONAL LEARNING ACTIVITIES FOR TEACHERS

Professional Learning activities offered to teachers were plentiful from January to December 2021. HOW MANY TK? These sessions demonstrated a high level of professional learning practice and had a positive impact on participants as will be discussed below in Evaluation Question 2. Even in the virtual environment, BOP staff provided an array of offerings that included a series of introductory and implementation video sessions (repeated once) to model and support teachers' installation and maintenance of Oyster Research Stations (ORS) when on-site field work resumed after the pandemic.

By late spring 2021 until December, when it was safe to gather in outdoor settings, the ORS sessions adopted a hybrid model, Day 1 online and Day 2 in-person at Governors Island. Other activities included: setting up oyster tanks in the classroom when students returned to in-person school; video exploration of oyster reef development; and prep sessions and 1:1 consultation with teachers to guide their students in developing projects for the annual student research

Symposium in June 2021. During the summer, the project offered a visit for teachers to the BOP CCRES oyster hatchery and headquarters at Governors Island.

From September to December, professional learning activities included several iterations of GIS sessions which introduced teachers to: the use of GIS mapping to locate future ORS sites and explored how to engage students in this GIS activity; setting up a classroom oyster tank; and introductory webinars and two-day training sessions for setting up oyster restoration stations with all materials provided by BOP CCRES.

PILLAR 4: ADVANCED RESEARCH METHODS TRAINING FOR TEACHERS

In this pillar, activities did not begin until BOP staff scheduled a series of events for July and August 2021 in collaboration with faculty and researchers from Cold Spring Harbor Laboratory, Brooklyn College, the Hudson River Project, and the eDNA Lab at CUNY York College, until the scientist facilitating these events transferred to California State University Monterey Bay. A first iteration of the session was provided in July 2021, a second iteration was held in November 2021. The eDNA Lab presentations were consistent with the high quality facilitation that the evaluator found in the project's other professional learning activities.

An Advanced Training session scheduled for July by the Hudson River Project to study the prevalence of enterococcus bacteria in the New York Harbor was cancelled due to a heat weather advisory. Cold Spring Harbor offered participants of their own summer lab sessions the opportunity to attend three ORS training sessions scheduled for the end of August to address advance research methods for students. It is not clear how many Cold Spring Harbor students participated in the ORS sessions. In the fall, a scientist from Brooklyn College facilitated two laboratory sessions for teachers, one session on water nutrients, the second on methods for testing water quality. The first session had no participants. Consequently, project staff and the evaluator who was observing the session took the opportunity to have the scientist run through his presentation and give him feedback.

DEVELOPMENT OF THE DIGITAL PLATFORM AND WEBSITE

The original concept of the digital platform was to develop a tool for teachers and students to gather and analyze oyster restoration data from the field, and to provide resources for teacher and student research. Parts of the website will go live this month, December 2021; the remainder will go live in 2022.

The platform is currently a collaboration between BOP-CCRES staff and teachers who are already participating in project activities, Fearless Solutions which is addressing the technical aspects, and Morgan Stanley which is contributing to the data entry and analysis aspects. In its current iteration, the platform also includes content developed by the BOP-CCRES project, such as the *Introduction to Species Guide*, a Guide to the annual Student Symposium, and Unit 1 of the project's teacher-piloted curriculum. Unit 2 will be posted on the platform in 2022 after teachers

pilot it in spring 2022.

BOP technical staff is currently working on redesigning the website to make it more relevant and a more individualized experience for teachers, as well as a resource to give teachers whatever they need to engage them and their students actively in BOP-CCRES activities. After interviews and feedback from six teachers, the BOP webmaster has revised the project's mission statement, making it more compelling and fully responsive to teachers' questions, such as "Why should I join BOP? What specifically do you offer teachers? How do I upload the oyster restoration data that students collect?" The website now includes buttons to go directly to these topics.

The Symposium Project section provides all the information and guidance a teacher needs to guide students in developing their research projects. Teachers will be able to search previous student projects, look at stand-out projects, search projects by student grade or by project topic. For the future, the team is looking into creating opportunities for teachers to share their lessons, and to create a profile for each teacher's field research site with photos to go along with the data the students are submitting. The team has also expanded, as well as streamlined ways to view and navigate the newly developed Unit 1 of the BOP curriculum, breaking the unit down to one-page presentations of each lesson.

ANNUAL STUDENT SYMPOSIUM

For the fourth year, the BOP CCRES project convened a symposium for students to present projects developed from their experience with Billion Oyster Project activities. Year 4 was the second year of a completely virtual symposium. By this second year, the online version of the symposium functioned very effectively. BOP staff masterly scheduled and facilitated the review of 124 student projects, developed by 213 students, facilitated by 16 teachers, reviewed by 33 guest judges over a one-week period in June 2021.

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EVALUATION QUESTION 2: TEACHERS
How well did the project work in supporting teachers and STEM professionals/scientists/ mentors to motivate students in developing interests, skills, knowledge, and career awareness in restoration science and related STEM fields?

PILLAR 3: PROFESSIONAL LEARNING FOR TEACHERS

What opportunities for training and professional development has the project provided?

RESULTS OF PROFESSIONAL LEARNING SURVEY

The Billion Oyster Project (BOP) offered professional learning activities for teachers and community scientists throughout the 2021 calendar year. Using programs modified during the previous year due to the ongoing COVID-19 pandemic and creating new workshops, BOP facilitated a combination of remote and in-person professional learning sessions, as changing COVID-19 conditions allowed. At the conclusion of each event, teachers responded to a survey designed to assess the effectiveness of the session in preparing them to develop and support students' scientific investigation skills and career awareness. Respondents rated the items on a scale of 1 (Strongly Disagree) to 6 (Strongly Agree).

In total, evaluators received 98 survey responses from teachers attending teacher professional learning activities from February to December 2021. The sessions included: *Oyster Research Station (ORS) Basic Training*, *Introduction to the Oyster Research Tank*, the *Inquiry from Anywhere* series, *Symposium Prep Sessions*, *Advanced Lab Training,* and *GIS Training* sessions. Evaluators reviewed results from these sessions related to teacher engagement and learning and their perceptions of students' engagement and learning. A summary of findings is presented below.

Demographic Overview of Respondents

The 98 responses to the survey represented educators in a range of roles, but the overwhelming majority were classroom teachers. As a result of these educators taking what they learned from BOP activities back to their classrooms and other contexts, 5,400 students or more could engage with BOP–CCRES content.
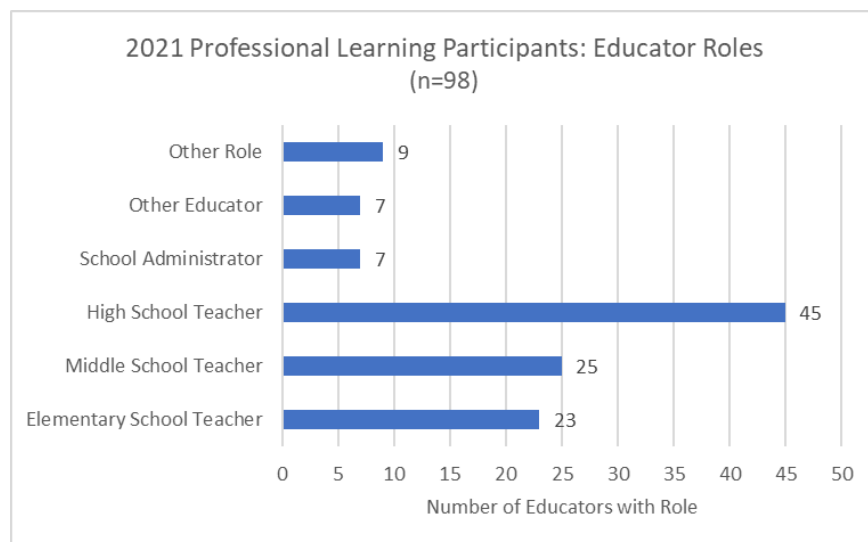
- Forty-five respondents (46 percent) were high school teachers. This was the most frequent answer for educator role.
- Twenty-five respondents (26 percent) were middle school teachers, and 23 identified as elementary teachers (23 percent).
- Those in other roles described their roles as:
  - *Paraprofessional*
  - *College Professor*
  - *Parent of Student*
  - *Laboratory Specialist*
  - *Special Education*
  - *Science Department Chairperson*
  - *Marine Biology Society moderator*
  - *ENL Teacher*
  - *After School Teacher*
  - *Program Administrator*
  - *Environmental Educator*

Reasons for Participation

Survey respondents were asked to indicate why they participated in the specific professional learning sessions they attended. Respondents could select more than one response.

2021 Professional Learning Participants: Why did you choose to participate in this session? (n=98)
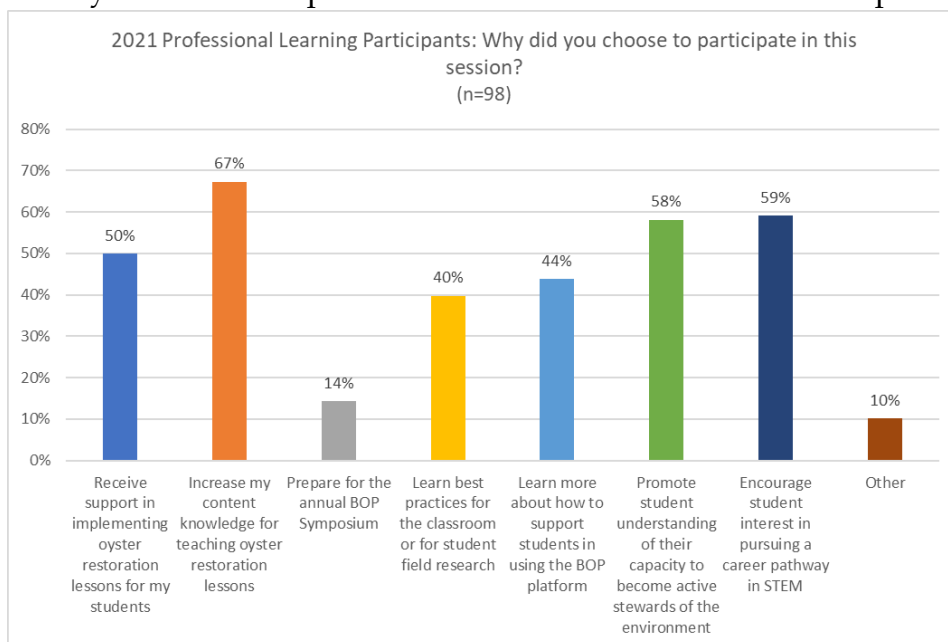
- The most common response was to *increase my content knowledge for teaching oyster restoration lessons*, with 67 percent of teachers citing this reason for participation.

- Other frequent responses include:
  - o *Encourage student interest in pursuing a career pathway in STEM* with 59 percent of teachers choosing this response
  - o *Promote student understanding of their capacity to become active stewards of the environment* with 58 percent of teachers choosing this response
  - o These reasons for participating in BOP professional learning suggest that teachers are actively looking for ways to engage their students in environmental content that connects to STEM careers and this attracts them to BOP programming.

Teacher Engagement and Learning

Teachers responded to a series of statements about what they learned from the professional learning session they attended. These statements were rated on a scale of 1 (Strongly Disagree) to 6 (Strongly Agree). Note: for these statements, respondents also had the option of "Not addressed in this session." Differences in n-values reflect those who selected "Not addressed."

2021 Professional Learning Participants: Teacher Knowledge and Engagement Following BOP Participation
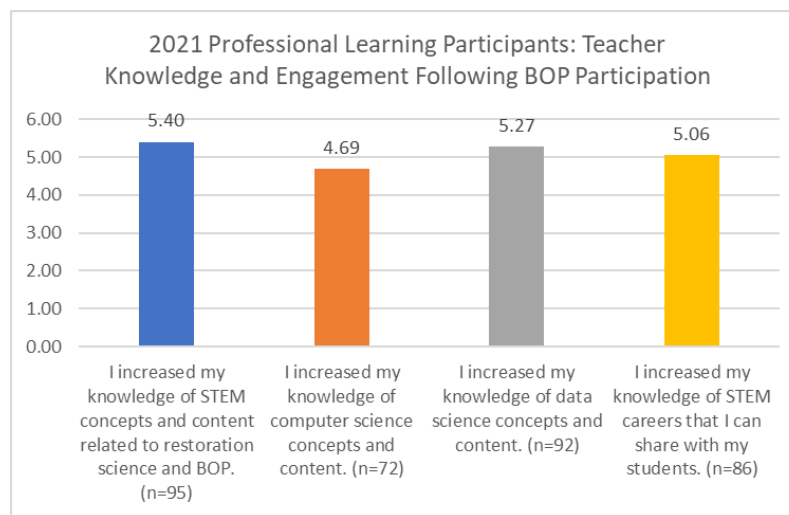
- Average responses to statements about what teachers learned in their professional learning were positive with averages about 4 (Somewhat Agree).
- The highest average was to the statement *I increased my knowledge of STEM concepts and content related to restoration science and BOP* with an average response of 5.40 (standard deviation=0.96).
- The lowest average response was to the statement *I increased my knowledge of computer science concepts and content* with an average of 4.69 (standard deviation=1.54). This outcome is not surprising as computer science is not the primary focus of professional learning sessions offered through ITEST.
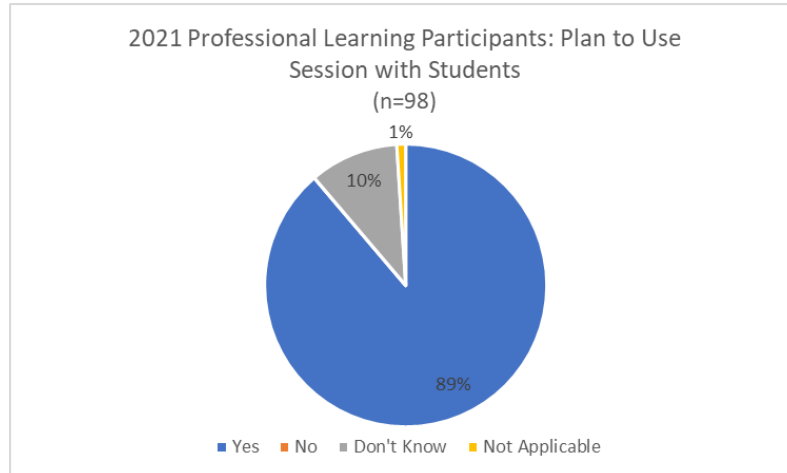
Overall high averages in both teacher learning and student engagement suggests that BOP met its goals in Year 4 in offering high quality professional learning sessions to educators that would prepare them to engage students in oyster restoration research activities.

2021 Professional Learning Participants: Plan to Attend Future BOP Sessions (n=98)
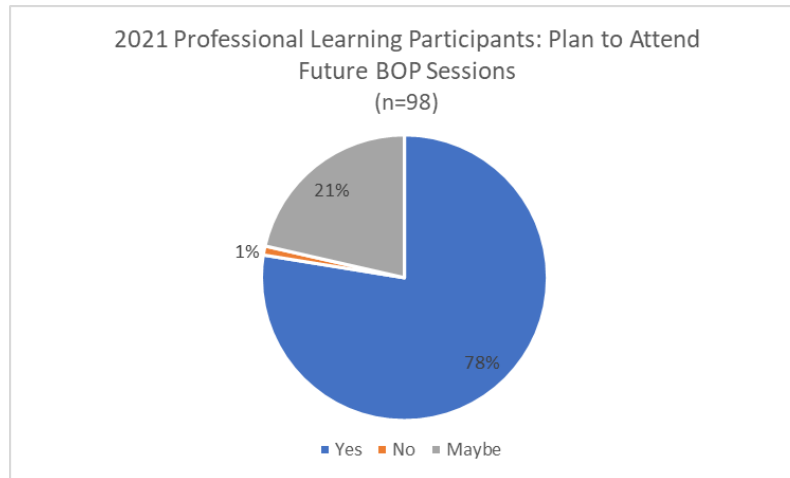
- Seventy-eight percent of respondents said that they planned to attend future BOP professional learning sessions.
- Twenty-one percent said that they would "maybe" attend future BOP professional leaning sessions. Barriers to attending future sessions included scheduling, information on what future session topics would be, and relevance to students.
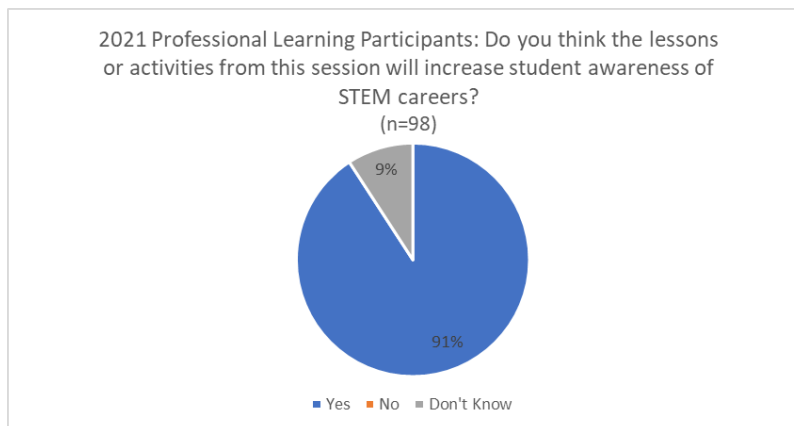
Teachers' Perceptions of Student Engagement and Learning

Potential student engagement and learning was analyzed through several factors: whether teachers plan to use professional learning activities with students; whether they think the session they attended will increase student STEM career knowledge; and whether they feel prepared to explore BOP content with students.

2021 Professional Learning Participants: Plan to Use Session with Students
(n=98)

1%
10%
89%

■ Yes ■ No ■ Don't Know ■ Not Applicable

- Eighty-nine percent of professional learning teacher participants plan to use BOP lessons, activities, or materials with their students. This suggests that BOP is providing lessons, materials, and activities that are useful for teachers and that teachers think will engage their students.
- Ten percent "don't know" if they will use their session with students.

Teachers' Perceptions of Student Career Awareness

2021 Professional Learning Participants: Do you think the lessons or activities from this session will increase student awareness of STEM careers?
(n=98)

9%
91%

■ Yes ■ No ■ Don't Know

- Ninety-one percent of teachers think that lessons or activities from BOP professional learning sessions will increase student awareness of STEM careers.
- Nine percent "don't know" if student awareness of STEM careers would increase.
- No respondents thought that BOP would definitely not increase student awareness of STEM careers.
- The high percentage of teachers thinking that BOP activities and lessons will increase student awareness of STEM careers also suggests that teachers are getting the outcomes

for themselves that they are seeking from BOP professional learning sessions, and reinforces BOP's role in providing this content.

Teachers' Application of Professional Learning Activities

Teachers responded to a series of statements about how they will engage with students based on what they learned from the professional learning session they attended. These statements were rated on a scale of 1 (Strongly Disagree) to 6 (Strongly Agree). Note: for these statements, respondents also had the option "Not addressed in this session." Differences in n-values reflect those who selected "Not addressed."
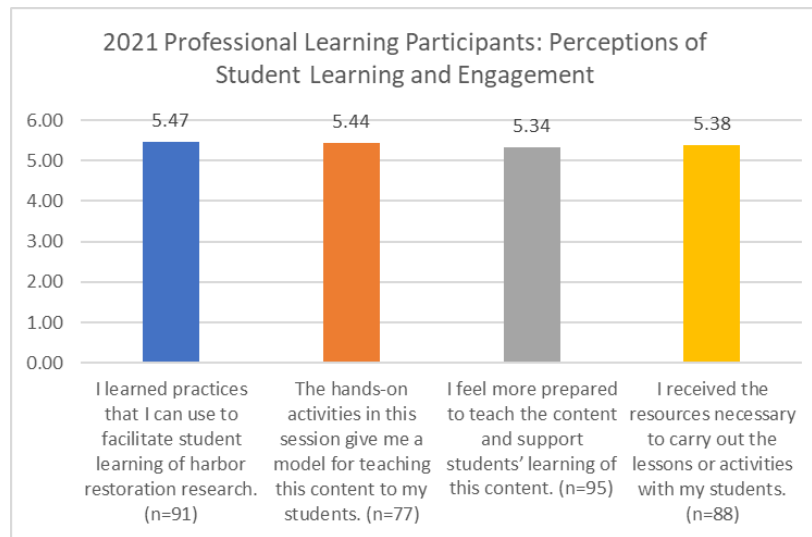
- Average responses to all statements were positive, with average responses between 5 (Agree) and 6 (Strongly Agree) to all.
- The statement with the highest average response was *I learned practices that I can use to facilitate student learning of harbor restoration research* with an average response of 5.47 (standard deviation=0.90).

RESULTS OF STUDENT SYMPOSIUM ACTIVITIES

Three BOP CCRES professional learning sessions were dedicated to preparing teachers to guide their students in generating and producing symposium projects for the annual Student Symposium which was held virtually for the second year in June 2021. Evaluators analyze these teacher responses in the Professional Learning Survey separately in this section, as well as including them in the analysis of overall professional learning activities in Year 4 above. Teachers responded to a series of statements about the new knowledge or learning they took away from the Symposium Prep sessions. These statements were rated on a scale of 1 (Strongly Disagree) to 6 (Strongly Agree). Note: Respondents also had the option "Not addressed in this session." Differences in n-values reflect those who selected "Not addressed."

Evaluators received eight responses from three dates of BOP Symposium prep sessions, 53 percent of the participants. One was a group session, others were "office hours" for 1:1 teacher consultation with BOP educators. For 13 percent of survey respondents, symposium preparation was their first time participating in any BOP programming.

Teacher Engagement and Learning

- Average responses about teacher learning from the Symposium Prep sessions were positive and were between 5 (Agree) and 6 (Strongly Agree).
- The highest average response was to the statement *I increased my knowledge of data science concepts and content* with an average of 5.67 (standard deviation=0.52

Teachers' Perceptions of Student Engagement and Learning

Teachers also responded to a series of statements about how they would engage with students based on what they learned from the Symposium Prep session they attended. Note: for these statements, respondents also had the option "Not addressed in this session." Differences in n-values reflect those who selected "Not addressed."

All respondents from the Symposium Prep sessions reported they planned to use the activities to work with students to develop symposium projects. Teachers reported they received project support from BOP staff educators to aid them in facilitating student research and project design. They also received feedback on students' symposium projects in progress.

- Average responses from teachers at the Symposium Prep sessions related to student engagement where highly positive and between 5 (Agree) and 6 (Strongly Agree). These sessions may be particularly effective at engaging students. The teachers attending these sessions were also motivated toward learning about how to engage students in research.
- The highest average response was to the statement *The hands-on activities in this session give me a model for teaching this content to my students* with an average of 6.00; however, three respondents felt this statement was not applicable to their session

The teachers' high average responses to the survey indicating they learned concrete ways to use Symposium Prep instructional strategies and materials with students provides evidence of high potential for student engagement and learning.

Student Symposium Presentations

A total of 16 teachers and 213 students participated in the virtual Student Symposium in June 2021. An external group of 33 scientists and educators acted as guest judges to provide feedback to students after they presented their projects. Each presentation and review session was 30 minutes long. In informal feedback from these sessions, teachers reported that the review sessions were a positive experience for their students. When asked about the sessions with reviewers, one teacher commented, "I think they were awesome. Being able to talk to the scientists from different backgrounds was helpful for the students. It also helped the students broaden their perspective of STEM careers." When asked about how BOP could support student project development, another teacher commented:

- *I appreciate the time taken by all the reviewers to talk to the students and give them feedback. Some are already thinking of [projects] they can do next year. The information session was helpful in planning and implementation. Hearing how other educators integrated it into their curriculum was also helpful.*

Teachers agreed that student participation in the symposium enabled students to learn about scientific research and STEM careers. They also reported that students were able to choose the type of project they produced and were able to collect field data for their projects, as well as using data provided by the BOP digital platform. Teachers commented that students' research projects increased their knowledge about oyster restoration.

Teachers gave suggestions about aspects of the virtual symposium that they would like to see continue once the symposium returns to an in-person event. One teacher commented, "The timing of the BOP Symposium is usually during the end of the year when there are many events at school so sometimes in the past it coincides with a school event. This year since it is virtual, we don't have to worry about logistics." This has been a concern in previous years as well. While it would be impossible to fit with every school's schedule, BOP staff could consider moving the symposium to May, before the end of the year-end rush of activities. However, it was a positive experience for teachers and their students which supported student learning and engagement in STEM projects and careers.

OVERALL RATING OF PROFESSIONAL LEARNING ACTIVITIES

Teachers had the opportunity to sum up their professional learning experience in Year 4 by rating each of the BOP professional learning sessions they attended on a scale of 1 (Poor) to 6 (Excellent).

2021 Professional Learning Participants: Rating of
Professional Learning Session
(n=98)
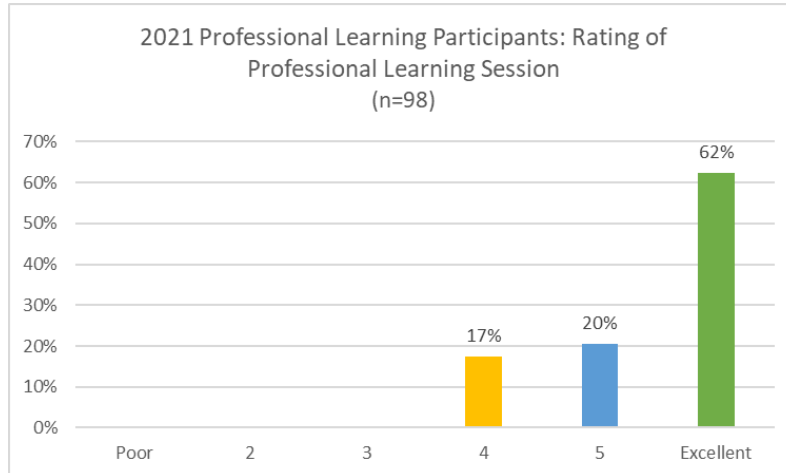
- Sixty-two percent of teachers rated their session as Excellent.
- No one rated the session as Poor.
- When asked for feedback to improve the professional learning sessions, feedback was in the following categories: interest in more in-person/hands-on sessions; additional resources for classroom use; more information on Billion Oyster Project as an organization and basics about oysters; and resources for adapting lessons to different students' needs.

Teacher outcomes from Billion Oyster Project professional learning sessions are positive. Overall, BOP succeeds in providing high quality professional learning that teachers can use to engage students in harbor restoration, environmental stewardship, and STEM careers.

SUMMARY OF PROFESSIONAL LEARNING SURVEY FINDINGS

Overall, data collected from a survey of teachers following their participation in BOP CCRES professional learning activities in Pillar 3 in Year 4, provides evidence that these sessions were successful and met the project's goals to provide support and resources for teachers to increase student engagement and learning in oyster restoration research, and to promote interest in STEM careers. Teachers reported consistently positive experiences throughout all BOP professional learning sessions. Ongoing participation in these activities gives teachers more resources for engaging their students and building STEM engagement and interest. Most sessions gave teachers clear ideas for how to get students involved in data science and research processes. Teachers also thought that students would increase their awareness of STEM careers as a result of participating in the BOP activities.

OBSERVATIONS OF PROFESSIONAL LEARNING ACTIVITIES

Observations of a sample of 15 teacher activities from February to December 2021 provided evidence to support the survey results. Activities observed included ORS Webinars, Oyster Tank Training sessions, STEM Hub activities, Career Webinars, Symposium Prep sessions, and

Advanced Lab Training activities. These sessions were evaluated using the *Observation Checklist for High-Quality Professional Development Training* developed by Noonan et al. (2016 - updated 2017) and adapted by evaluators for use in BOP professional learning sessions. (See Appendix.) According to Gaumer Erickson et al. (2016), "this checklist was designed specifically to: 1) evaluate training on the inclusion of research-based adult learning inquiry components that have been shown to increase the knowledge and skills to implement practices; and 2) provide guidance for training providers to help them improve their practices."

The observation protocol was used in all observations. Each of the 15 items on the *Checklist for High-Quality Professional Development Training* represent a best professional development practice. The instrument uses a 'yes' (1) or 'no' (0) rating system, indicating the presence or lack of presence of each of the desired practices assessed by the protocol. For this report, results are presented in three categories: *organization practices, facilitator practices, and participant practices*.

Note: Sessions presented in the webinar format were not designed to be interactive or to engage participants directly. The relevant survey items were deemed "Not Applicable" and were not included in the analysis.

OBSERVATIONS OF PREOFESIONAL LEARNING SESSIONS

Organization Practices

Evaluators looked for the presence of three best practices in the category of organization as indicators of effective practice during each session. Organization items relate to preparation for the session and managing time within the session. The percentage of sessions in which the specified practices were observed are listed below.

Item	Percent of Sessions Item Observed
Provides a description of the training with learning objectives prior to training	93%
Provides an agenda before or at the beginning of the training/activity	80%
Adheres to agenda and time constraints	100%
Average of Organization Practices Observed	**Average 91%**

In the majority of sessions observed, participants were informed about the content and purpose of the session. Descriptions of the sessions were included on the BOP Eventbrite webpage when teachers registered for the event. BOP facilitators also provided a verbal or screen shot description of the session activities and learning objectives at the beginning of sessions. The desired organization practices were observed in an average of 91percent of the sessions.

Facilitator Practices

Evaluators looked for eight practices from the facilitator in the sessions observed that indicated high-quality facilitation. These items are actions that connect participants to the topic of the session; emphasize the importance of the content and practices in the session; and provide resources and access to future consultation during and following the session. These items are listed below.

Item	Percent of Sessions Item Observed
Establishes rapport with participants from beginning of the session	93%
Connects topic to participants' context	62%
Content builds on or relates to participants' previous sessions – where applicable (not applicable to all sessions)*	100%
Aligns with organizational standards or goals	100%
Emphasizes impact of content	54%
Builds and reiterates shared vocabulary required to implement and sustain the session	93%
Provides examples of the content/practice in use	100%
Offers opportunities for continued learning through technical assistance and/or resources.	93%
Average of Facilitator Practices Observed	**Average 87%**

Best practices in the '*Facilitator Actions*' category were observed in an average of 87 percent of the sessions. Where applicable, most facilitators followed the practice of inquiry in which participants interacted with the facilitator and participants interacted with each other in trying out and reflecting on the activities they were doing.

*Note: The item "*Facilitators connected to or built on prior training*" was not applicable to all activities observed as some were stand-alone or entry level sessions. While not all participants attended a previous session in a series, or they were first-time BOP participants, facilitators created a context and connections for the participants to other BOP activities.

Participant Practices

In the sessions observed, evaluators looked for four practices which created opportunities for participants to be actively and directly involved in the session. These items relate to: providing opportunities for participants to use the skills and content in the session; encouraging participants to express their ideas and work together with session participants to build on the session ideas; and allocating time for individual and group interactions to reflect on the learning. These items are listed below. An average of 88.5 percent of the relevant sessions demonstrated evidence of the desired practices in this category.

Item	Percent of Sessions Practice Observed
Includes opportunities for participants to apply content and/or practice skills during training (excluding webinars)	100%
Includes opportunities for participants to express personal perspectives	85%
Facilitates opportunities for participants to interact with each other related to training content	92%
Includes opportunities for participants to reflect on learning	77%
Average of Participants' Actions Observed	**Average 88.5%**
OVERALL AVERAGE OF DESIRED PRACTICES	**Overall Average 89%**

SUMMARY OF PROFESSIONAL OBSERVATION RESULTS

The data collected from observations of a sample of BOP CCRES professional learning activities contribute to answering Evaluation Question 2 and achieving one of the project's major goals: preparing teachers to develop student engagement and learning in Oyster Restoration Research. The majority of practices identified as characteristics of high-quality facilitation were observed in an average of 89 percent of sessions. Where applicable, an integral element of the design and implementation of the BOP-CCRES activities was the interactive component.
Reminder: Webinar sessions were not designed as participant interactive experiences so the relevant practices were not included in the session, and not included in the analysis.

Providing opportunities for participants to play an active role in oyster research restoration is important to achieving high-quality professional learning sessions, as these practices can be carried over to the classroom. Teachers report in their participant survey that these qualities are what makes BOP CCRES sessions successful for them. Responses also reflect that teachers plan to attend more Billion Oyster Project professional learning sessions in the future.
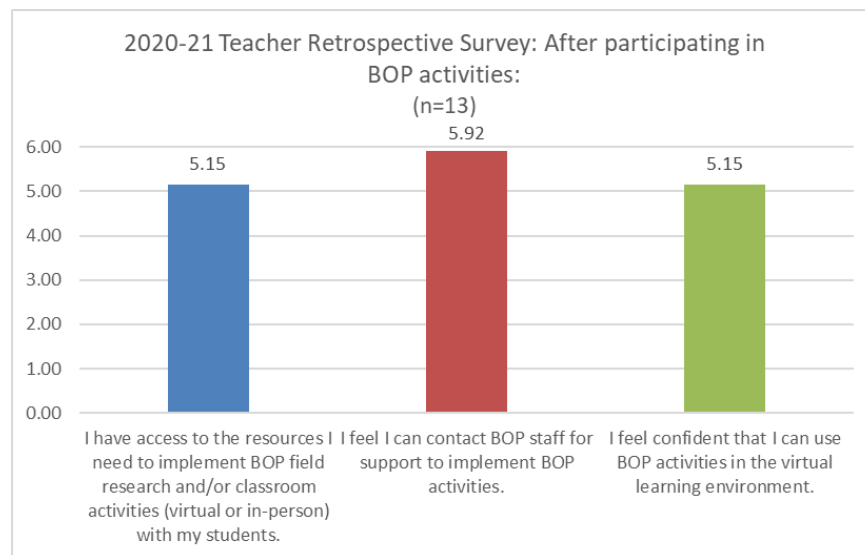
TEACHER RETROSPECTIVE SURVEY

A second teacher survey, the *Teacher Retrospective Survey*, was administered in June 2021 to participants of all BOP activities from September 2020 to June 2021. This survey was designed to give teachers the opportunity to look back on the entirety of their BOP experiences at the end of the 20-21 school year to assess the value and impact of the project activities in supporting them and their students over the year in oyster restoration research and developing STEM career awareness.

RESULTS FROM TEACHER RETROSPECTIVE SURVEY
Supporting Teachers in Oyster Restoration Research

Analysis of the year-end *Retrospective Teacher Survey* data shows:
- following participation in BOP activities (all virtual), respondents felt positively about the support they received from BOP throughout the year. Participants' average responses to these statements fell between 5 (Agree) and 6 (Strongly Agree) on a Likert scale of 1 to 6.

- The highest average response was to the statement *I feel I can contact BOP staff for support to implement BOP activities* with an average of 5.92 (standard deviation=0.28).
- Two statements received an average of 5.15:
  - *I have access to the resources I need to implement BOP field research and/or classroom activities (virtual and/or in-person) with my students* (standard deviation=1.14).
  - *I feel confident that I can use BOP activities in the virtual learning environment* (standard deviation=1.41).

High average responses in this category suggests that BOP staff has been successful in providing teachers with the resources and support they need to use BOP activities with their students and in delivering both virtual and in-person sessions.
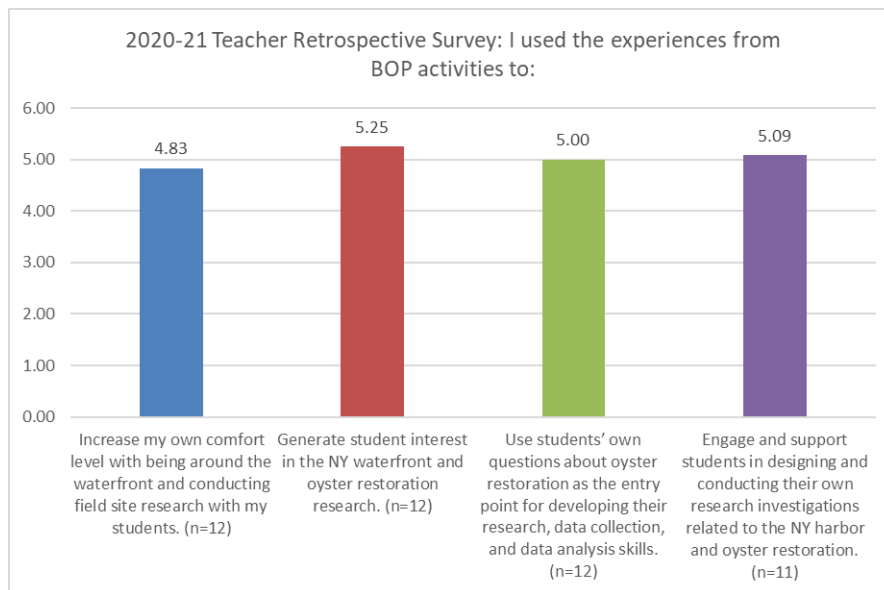
Teacher Engagement and Learning

Teachers also responded positively to the impact of BOP in their understanding of oyster restoration research, with average responses between 5 (Agree) and 6 (Strongly Agree).

- The statement *My experience in BOP has increased my awareness of what is happening with oyster restoration in the New York Harbor* received an average response of 5.77 (standard deviation=0.44).
- The statement *My experience in BOP had exposed me to ways to engage my students in virtual or in-person field site or classroom oyster restoration research* received an average response of 5.46 (standard deviation=1.13).

These responses suggest that the BOP CCRES project provided teachers with a range of ways to involve students and contributed to meeting one of the goals to develop student engagement in oyster restoration in the New York Harbor.

Teachers' Perceptions of Student Engagement and Learning

A third category of questions in the *Teacher Retrospective Survey* focused on using BOP experiences to conduct research with students. Responses to these statements, while still positive, were lower than others. Average responses to these statements mostly were close to 5 (Agree).

2020-21 Teacher Retrospective Survey: I used the experiences from BOP activities to:

Increase my own comfort level with being around the waterfront and conducting field site research with my students. (n=12)	4.83
Generate student interest in the NY waterfront and oyster restoration research. (n=12)	5.25
Use students' own questions about oyster restoration as the entry point for developing their research, data collection, and data analysis skills. (n=12)	5.00
Engage and support students in designing and conducting their own research investigations related to the NY harbor and oyster restoration. (n=11)	5.09

- The statement with the highest average response was *I used the experiences from BOP activities to generate student interest in the New York waterfront and oyster restoration research* with an average of 5.25 (standard deviation=1.14).

Supporting Teachers in Student Symposium Activities

The *Teacher Retrospective Survey* included questions about the extent and nature of teacher and student participation in the virtual June 2021 Student Symposium.

- Thirty-eight percent of teachers responding to these questions reported that they facilitated students' generation of oyster restoration research projects. Among teachers who reported their students presented projects, one teacher had elementary age students, one had middle school grades, and three had high school grade students.
- Among teachers whose students did research projects, 40 percent reported that they presented at the virtual BOP symposium.
- Sixty-two percent of respondents did not engage students in oyster restoration research projects.

Teachers who reported that their students created their own oyster research projects were asked how BOP materials and data were used in their research. Teachers could select multiple sources of information.
- Four teachers reported using data provided by the BOP digital in their students' research.
- Two teachers used other sources of data and research for their students

Teachers' Perceptions of Student STEM Career Knowledge and Interest

A key objective of BOP activities is for teachers to raise student awareness and interest in a range of marine-related STEM careers and build interest in those careers.
- Eighty-five percent of respondents reported they attended activities where they learned how to develop students' awareness of STEM careers.
- The average response to the statement *BOP activities modeled practices and instructional activities that I can use to motivate students to follow careers in STEM fields* was positive at 5.33 (standard deviation=0.65).

Teachers were also asked what impact those career awareness activities had on their students.
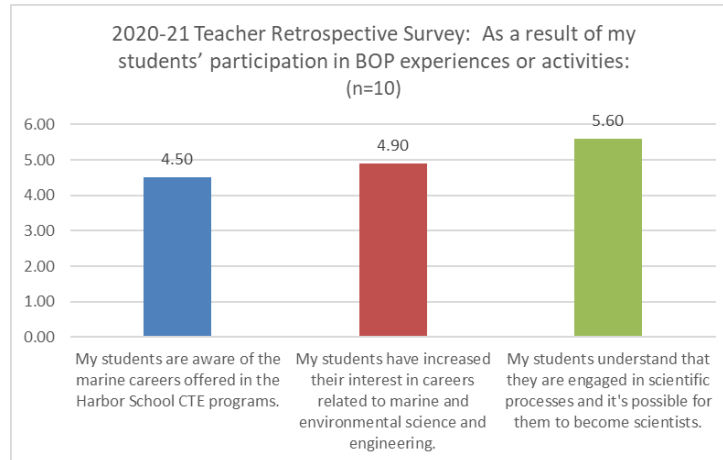
2020-21 Teacher Retrospective Survey: As a result of my students' participation in BOP experiences or activities: (n=10)

- Responses to STEM career awareness and interest were mixed, but still positive overall.
- The highest average response was to the statement *As a result of my students' participation in BOP experiences or activities, my students understand that they are engaged in scientific processes and it's possible for them to become scientists* with an average of 5.60 (standard deviation=0.70).
- The lowest average response was to the statement *As a result of my students' participation in BOP experiences or activities, my students are aware of the marine careers offered in the Harbor School CTE programs* with an average of 4.50 (standard deviation=1.43).

While marine science careers may be mentioned in a wide range of BOP activities, the Harbor School CTE programs may not be mentioned specifically by name, therefore limiting teachers' explicit knowledge of the programs.

SUMMARY OF TEACHER RETROSPECTIVE SURVEY FINDINGS

Teachers who participated in the 2020-21 Retrospective Survey attended a range of BOP CCRES activities during the school year. Participants reported positive experiences both in professional learning sessions and in using BOP lessons and activities in their classrooms. All respondents used their participation as a way to teach students about harbor restoration and some used it as an entry to students' own scientific research. The majority of respondents thought that BOP activities facilitated teachers' abilities to develop students' interest in STEM careers, although outcomes varied by grade level and teacher experience. All around teachers reported a positive and impactful experience with Billion Oyster Project. Encouraging more BOP professional learning participants in preparing and guiding students in generating their own Symposium projects, however, is an area that needs improvement. The prospect of a live, in-person symposium in June 22 might promote greater teacher interest in participation.

EVALUATION QUESTION 3: STUDENTS
How well did the project work in supporting students to engage in STEM, increase career awareness, and motivate them to pursue STEM interests, skills, and follow formal educational pathways in the New York City public school system.

PILLAR 1: STEM HUBS

In order to evaluate to what extent the BOP CCRES ITEST project met its goals to increase student learning in oyster restoration and raise student awareness of possible careers in STEM and STEM fields, students had the opportunity to respond to several evaluation questions that were included in the project's *Student Research Survey.* Students from many different schools who participated in the BOP CCRES ITEST project's Pillar 1: STEM Hub activities responded to these questions at the conclusion of each event to assess their perceptions of their scientific skills and STEM career knowledge. The findings are presented in three sections below: survey responses collected from January to March 2021, from April to June 2021, and for the entire year – January to December 2021.

RESULTS FROM PILLAR 1: STEM HUB ACTIVITIES – January to March 2021

Evaluators identified 20 students who had attended STEM Hub events online from January-March 2021 who responded to questions on the Student Research Survey. Respondents answered questions on a scale of 1 to 5, which 1 being the most negative and 5 being the most positive.

Student Perceptions of Science Skills
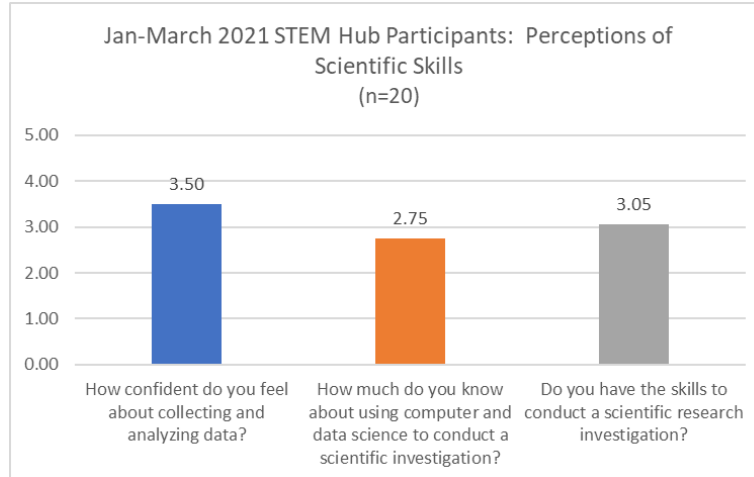
Jan-March 2021 STEM Hub Participants: Perceptions of Scientific Skills (n=20)

- The most positive response was to the question *How confident do you feel about collecting and analyzing data?* with an average response was 3.50 (standard deviation=0.89). On average, students report having some confidence in collecting and analyzing data.

Student STEM Career Knowledge and Interest

Students also responded to a question about their knowledge of STEM careers connected to harbor restoration and environmental science. Students responded on a scale of 1 (Almost Nothing) to 5 (A lot)

- The average response to STEM career awareness was 3.15.
- Sixty-five percent of students responded that they know some about these careers in the middle of the scale.
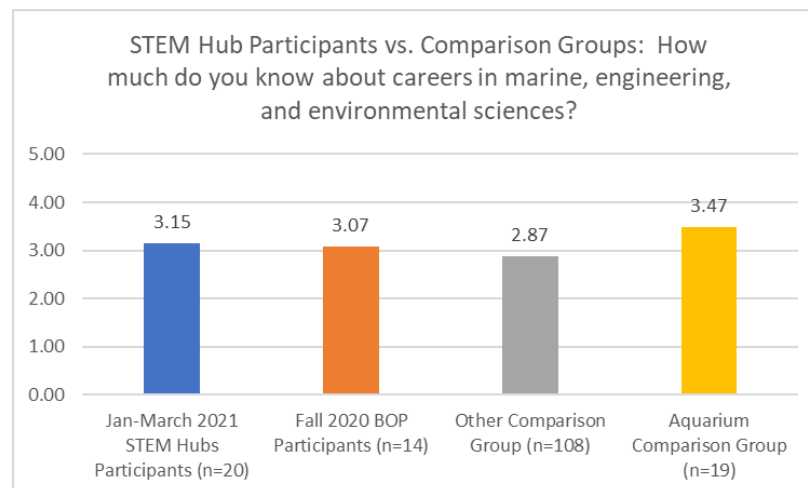
Comparison Groups: Student Perceptions of Science Skills

January-March STEM Hub student participants' responses were compared to three groups of students: STEM Hub participants from the Fall 2020 semester, students from Fall 2020 who completed a survey but had no experience with BOP or another science organization, and a group of students who participated in New York Aquarium programming.

STEM Hub Participants vs Comparison Group: Perceptions of Scientific Skills
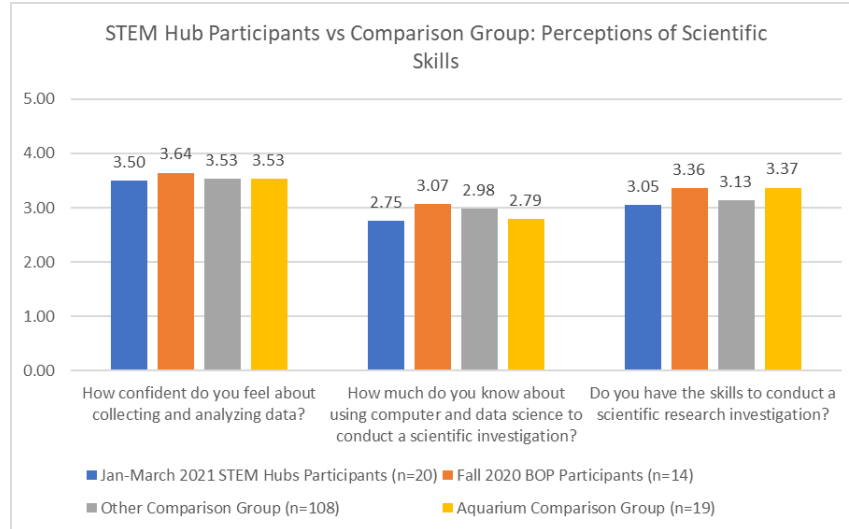
- January-March STEM Hub participants had lower average responses to all questions related to scientific skills than the participants from Fall 2020.
- Participants' responses were similar to or slightly lower than students who had not participated in the STEM Hub activities.

Comparison Groups: Student Perceptions of STEM Career Knowledge and Interest

STEM Hub Participants vs. Comparison Groups: How much do you know about careers in marine, engineering, and environmental sciences?
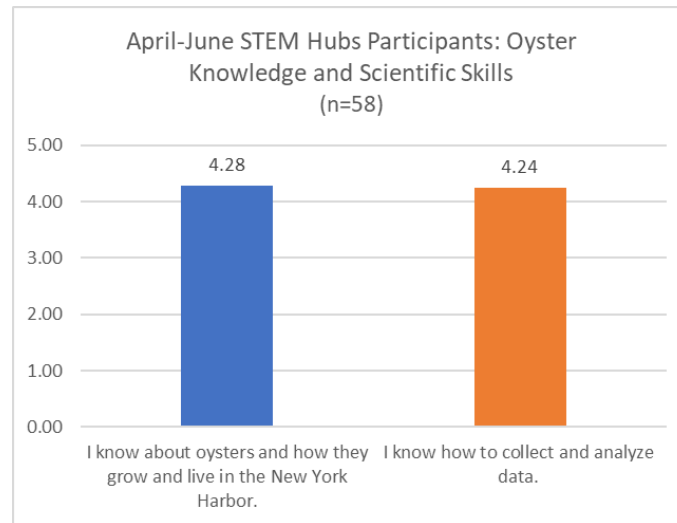
- January-March STEM Hub participants felt more positively about their STEM career knowledge than the Fall 2020 participants and the general comparison group. They responded less positively than the New York Aquarium students.

RESULTS FROM STEM HUB ACTIVITIES – April to June 2021

In April 2021, BOP staff and evaluators worked together to revise the student evaluation survey. Questions were modified to more closely align to BOP events in which students were participating and also to make the survey process easier. Evaluators identified 58 students who participated in STEM Hub activities from April-June and completed the Student Research Survey.

Student Perceptions of Science Skills

In a new iteration of the *Student Research Survey*, students responded to statements about oyster knowledge and scientific skills. All statements were rated on a scale of 1 (Strongly Disagree) to 5 (Strongly Agree).

- STEM Hub participants' average responses to both statements were positive and were between 4 (Agree) and 5 (Strongly Agree).
- *I know about oysters and how they grow and live in the New York Harbor* had an average response of 4.28 (standard deviation=0.67)
- *I know how to collect and analyze data* had an average response of 4.24 (standard deviation=0.68).
    - For students taking the Jan-March version of the survey, the statement about collecting and analyzing data received the most positive response.
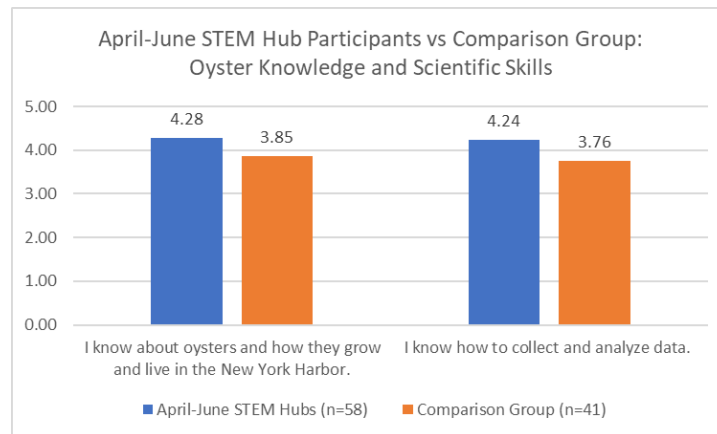
Student STEM Career Knowledge and Interest

- The average response to STEM career knowledge for April-June STEM Hub participants was 3.89.
- Seventy-two percent of respondents agreed to some extent with the statement *I know about careers in marine, engineering, and environmental sciences by participating in this activity.*
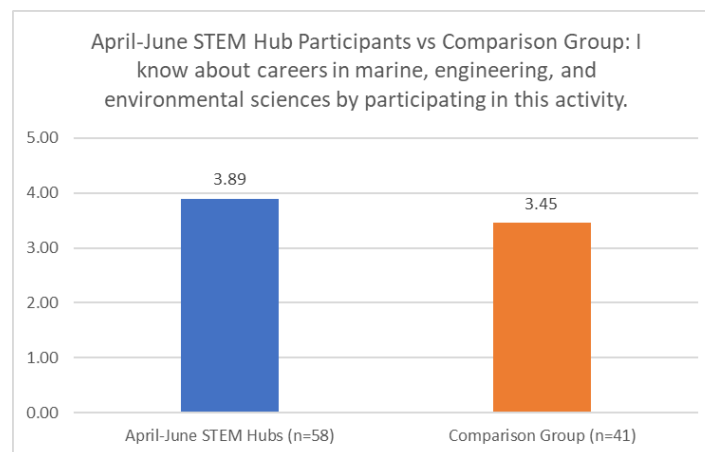
- o This statement was changed on a third version of the survey to make it more specific to the activity which students attended before taking the survey, in order to make responses clearer.

STEM Hub Activities and Comparison Groups

Evaluators compared STEM Hub participant surveys to surveys from students who took the student evaluation survey from April-July but could not be connected to participation in a BOP activity.

April-June STEM Hub Participants vs Comparison Group: Oyster Knowledge and Scientific Skills

- STEM Hub participants reported knowing more about oysters than the comparison group. The average response was 0.43 higher.
- STEM Hub participants' average response to the *statement I know how to collect and analyze data* was more positive than the comparison group by 0.48 points.
- Unpaired t-tests were performed. These results were statistically significant.

April-June STEM Hub Participants vs Comparison Group: I know about careers in marine, engineering, and environmental sciences by participating in this activity.

- STEM Hub participants reported more marine, engineering, and environmental science career knowledge than the comparison group. The average response was 0.44 points higher.
- Unpaired t-test were conducted on the results for the STEM Hub participants and the control group. The results were statistically significant.

RESULTS FROM STEM HUB ACTIVITIES, October-November 2021

In summer 2021, the Student Research Survey was taken offline for the second time to further streamline the experience for students and make it easier for them to complete the survey and obtain parental consent. This pause resulted in less time to collect data during the fall 2021 semester. Consequently, the analysis of student survey results consists of responses generated primarily from a hybrid model of online and in-person events from October to November 2021. Evaluators established each respondent's participation in BOP programming by correlating the date of Billion Oyster Project student events to the date when participants initiated their survey responses. Surveys which were begun within a week of an event were considered to be "participant surveys" and were included in the analysis. Evaluators identified 132 students who participated in STEM Hub activities and took the student survey.

Student Knowledge and Scientific Skills

Students responded to statements about their oyster knowledge and scientific research skills. All statements were rated on a scale of 1 (Strongly Disagree) to 5 (Strongly Agree).
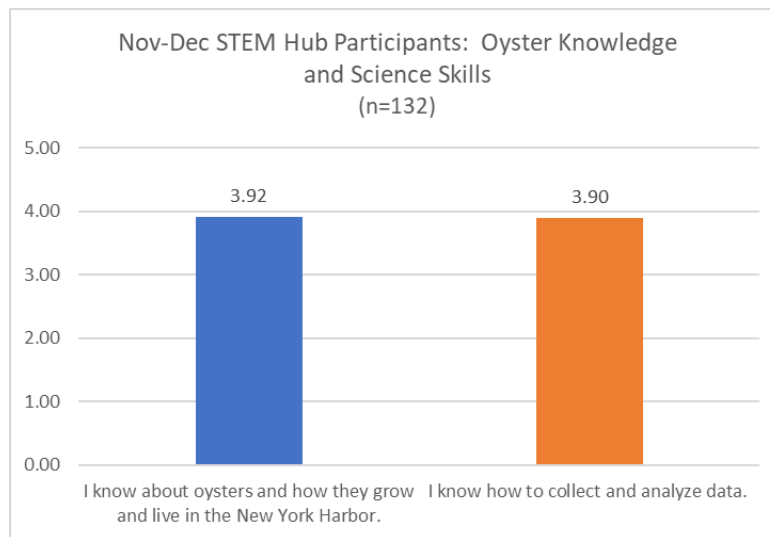
- Average responses to both statements were somewhat positive and were approaching 4 (Agree).
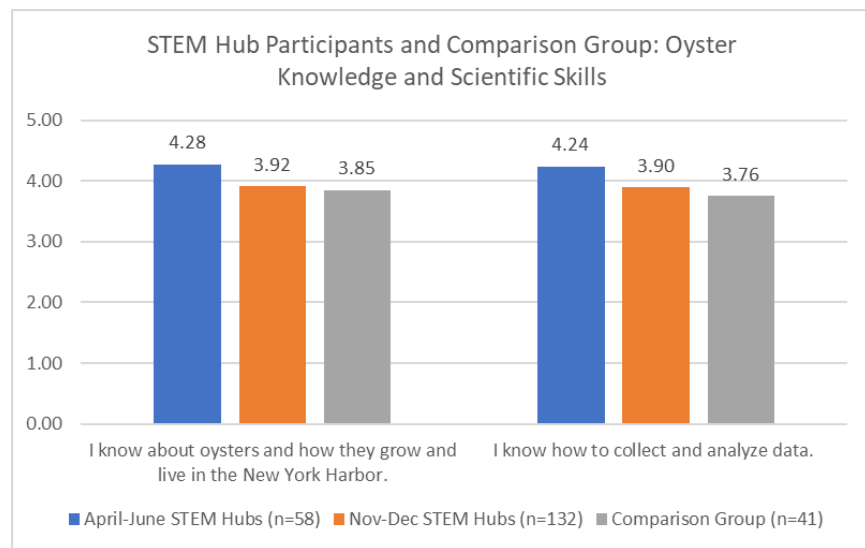
Student STEM Career Knowledge

STEM Hub participants responded to a statement about how much they learned about STEM marine-related careers through their participation.
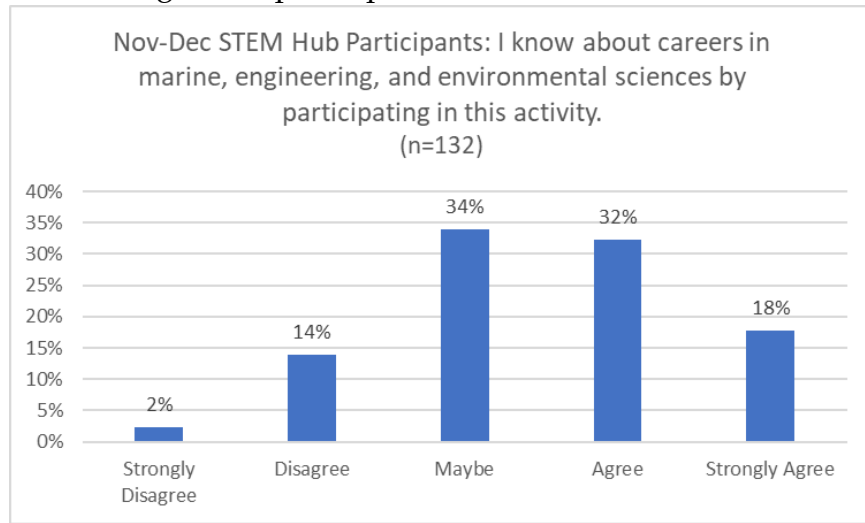

- Fifty percent of respondents agreed to some extent that they knew more about careers in marine, engineering, and environmental sciences by participating in BOP STEM Hub activities.
- An additional 34 percent thought they 'maybe' knew more about those careers.

STEM Hub Activities and Comparison Groups

Evaluators compared Fall 2021 STEM Hub participant survey outcomes to results from STEM Hub participants from April-July 2021 and to students who took the student evaluation survey from April-July but could not be connected to participation in a BOP activity.

- Average responses about oyster knowledge and scientific skills from Fall 2021 STEM Hub participants were higher than those from students who were in the comparison group and did not participate in BOP activities. Unpaired t-tests were performed; the results were not statistically significant.
- Average responses from Fall 2021 STEM Hub participants were lower than the average responses from Spring 2021 participants.

STEM Hub Participants and Comparison Group: STEM Career Knowledge
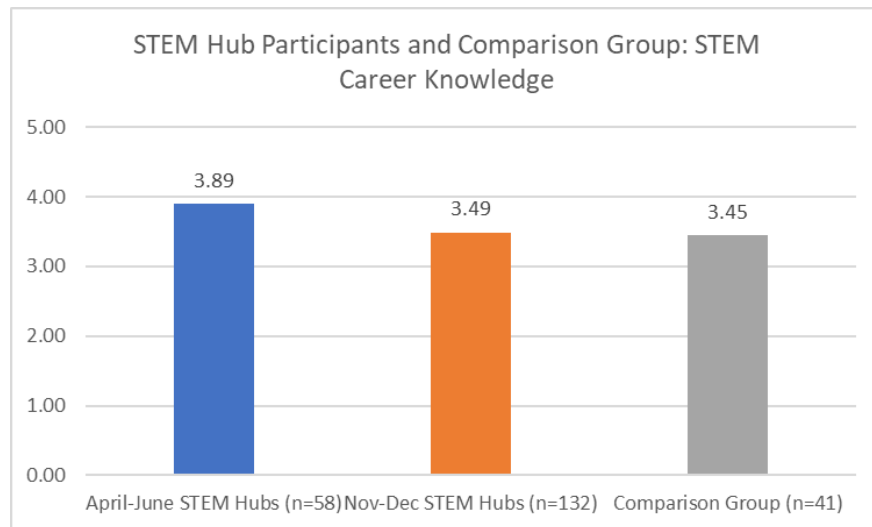
- The average response about STEM career knowledge from Fall 2021 STEM Hub participants was slightly higher than the average from students who were in the comparison group and did not participate in BOP activities. An unpaired t-test was performed; the results were not statistically significant.
- The average response from Fall 2021 STEM Hub participants was lower than the average from Spring 2021 participants.

For students attending in-person STEM Hubs in Fall 2021, it may have been their first exposure to in-person BOP and oyster restoration activities. In-person activities expected for spring 2022 may increase students STEM Career awareness. As teachers and students are able to do more on-site fieldwork, depending on COVID-19 conditions, they may have more opportunities to engage with BOP at STEM Hub sites or through classroom activities.

PILLAR 2: NEAR PEER MENTORING

There were three components of the Pillar 2: Near Peer Mentoring activities: Career Panel webinars, and a mentor-mentee program which originated at the Harbor School as an afterschool program for juniors as mentors and freshmen as mentees, This intra-school model was adopted because the logistics of facilitating Harbor School students' afterschool travel off Governors

Island (which is dependent on the ferry boat schedule) to any other school or location in New York City made any inter-school mentoring activities a challenge.

However, a third Near-Peer Mentoring feature was developed in Spring 2021 between the high school mentors and Grades 3 and 4 students at PS 676 in Red Hook in Brooklyn to build the younger students' experience of the New York Harbor and awareness of marine careers and opportunities at the Harbor School. This inter-school mentoring relationship was facilitated by the use of a Harbor School boat to travel from Governor's Island across the harbor to Red Hook. The elementary students were not asked to respond to the Student Research Survey.
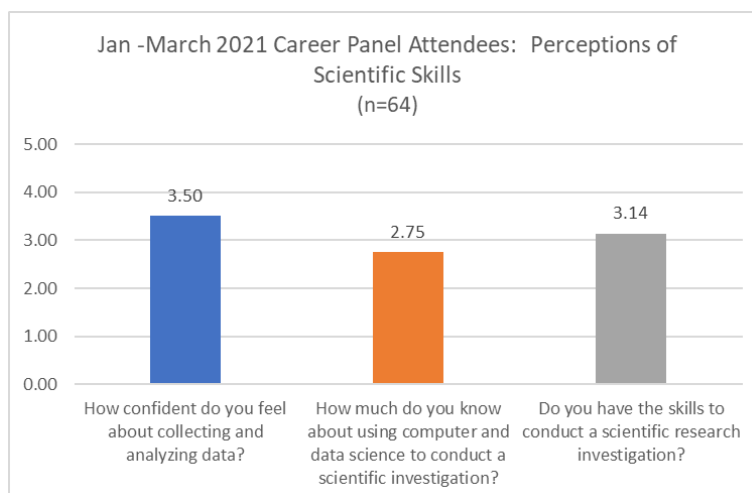
CAREER PANEL WEBINARS

During the Spring 2021 semester, Billion Oyster Project facilitated a series of career panels addressing marine-related STEM professions which were moderated by Harbor School mentors to focus on one of the seven STEM marine career tracks offered at the Harbor School, a Career and Technical Education school (CTE): Aquaculture, Marine Biology Research, Marine Systems Technology, Marine Affairs Policy & Advocacy, Ocean Engineering, Professional Diving, and Vessel Operations. Panelists included Harbor School alumni and other professionals who worked in jobs related to those careers. The panels were presented as webinars and did not include opportunities for participants to actively engage in learning and practicing skills. Students who attended those programs responded to the Student Research Survey at the conclusion of the events.

The career panels were not offered in Fall 2021, but six panels are scheduled for the Spring 2022 semester.

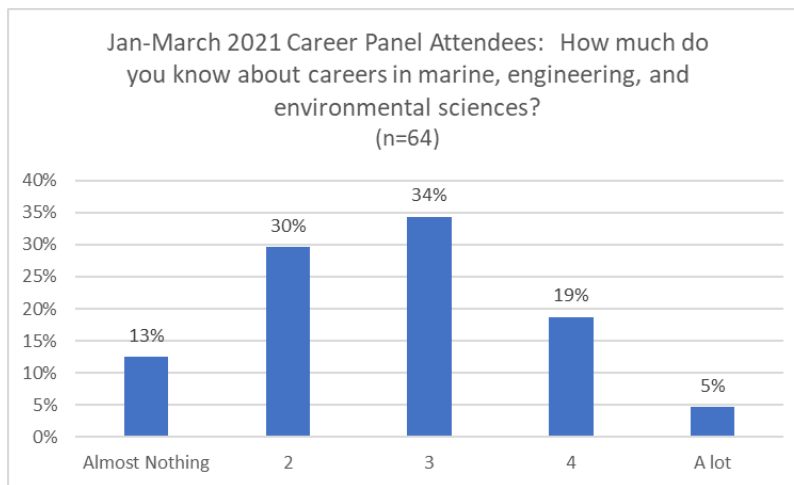### *Student Perceptions of Scientific Skills*

Evaluators identified 64 students who had attended Career Panel webinars from January-March 2021. Survey questions were answered on a scale of 1 to 5, which 1 being the most negative and 5 being the most positive.

- The highest average response was to the question *How confident do you feel about collecting and analyzing data?* with an average response of 3.50 (standard deviation=0.93). Students have some confidence in collecting and analyzing data.
- The lowest average response was to the question *How much do you know about using computer and data science to conduct a scientific investigation?* with an average response of 2.75 (standard deviation=1.05). Building computer and data science skills was not a focus of these panels.

### *Student STEM Career Knowledge*

Students also responded to a question about their knowledge of STEM careers connected to marine careers and environmental science. Students responded on a scale of 1 (Almost Nothing) to 5 (A lot)

Jan-March 2021 Career Panel Attendees: How much do you know about careers in marine, engineering, and environmental sciences? (n=64)
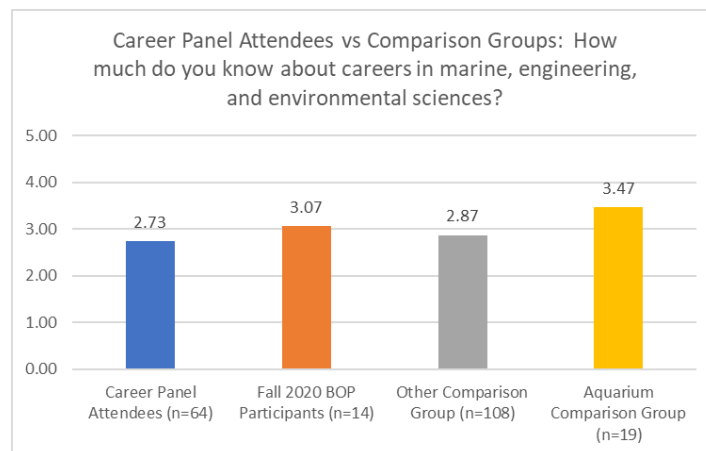
- The average response to this question was 2.74.
- Thirty-four percent responded that they knew an average amount about these careers.
- Twenty-four percent responded that they knew more than an average amount.
- Forty-three percent responded that they knew less.

Career Panel Student Attendees and Comparison Groups

Career Panel attendees' responses were compared to three groups of students: STEM Hub participants from the Fall 2020 semester, students from Fall 2020 who completed a survey but had no experience with BOP or another science organization, and a group of students who participated in New York Aquarium programming.

Career Panel Attendees vs Comparison Groups: Perceptions of Scientific Skills
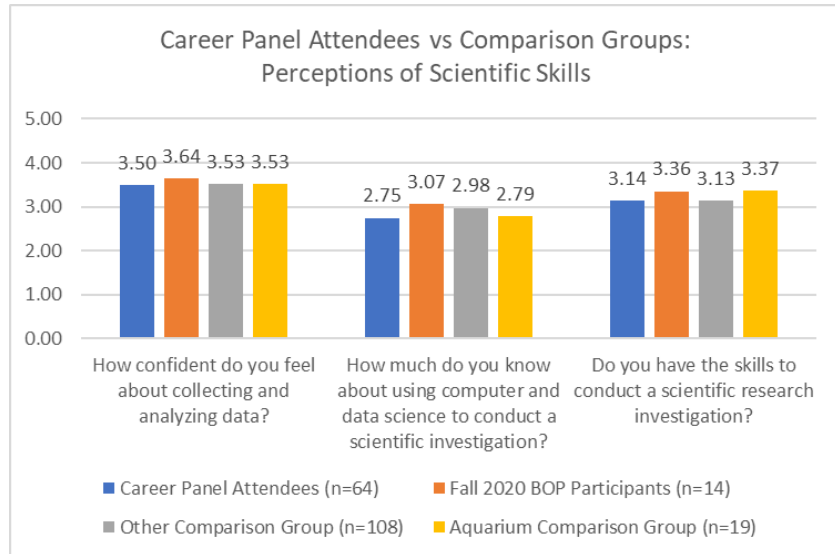
- Career panel attendees' average responses were lower than the Fall 2020 STEM Hub participants' responses in perceptions of scientific skills.
- The average responses on scientific skills were similar to or lower than the students in the comparison groups. The panels were webinars and did not include activities for participants to actively learn or utilize these skills. These results may reflect that.

Career Panel Attendees vs Comparison Groups: How much do you know about careers in marine, engineering, and environmental sciences?

- The career panel attendees' average response about their STEM career knowledge was lower than students in all the other groups.
- This result is surprising, and there may be some bias in these results. Evaluators do not know how teachers or students chose to attend the career panels. Teachers may have wanted students to attend because they thought they needed to learn more about STEM careers. Additionally, in particular when compared with the general comparison group this may be a case of "you don't know what you don't know," in which students who

heard about fields they previously did not know about may have been inclined to respond lower to this question that students who had not participated in any program.

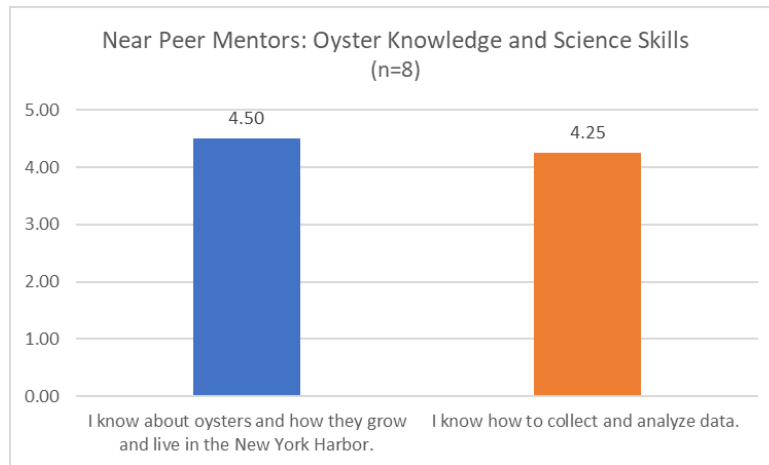## *NEAR PEER MENTORING ACTIVITIES*

The Harbor School also hosted Pillar 2: Near Peer mentoring activities with the Harbor Corps afterschool program which designated Harbor School juniors as mentors and freshmen as mentees. In weekly meetings, students from each career track offered at the Harbor school took turns facilitating the sessions to help freshmen navigate their first year at the Harbor School, and choosing a career track. Evaluators identified eight students who self-identified as mentors and took the Student Research Survey on the dates of scheduled Harbor Corps meetings.

Mentors responded to three statements about their activities with Harbor Corps Near Peer mentoring program. All statements were rated on a scale of 1 (Strongly Disagree) to 5 (Strongly Agree).
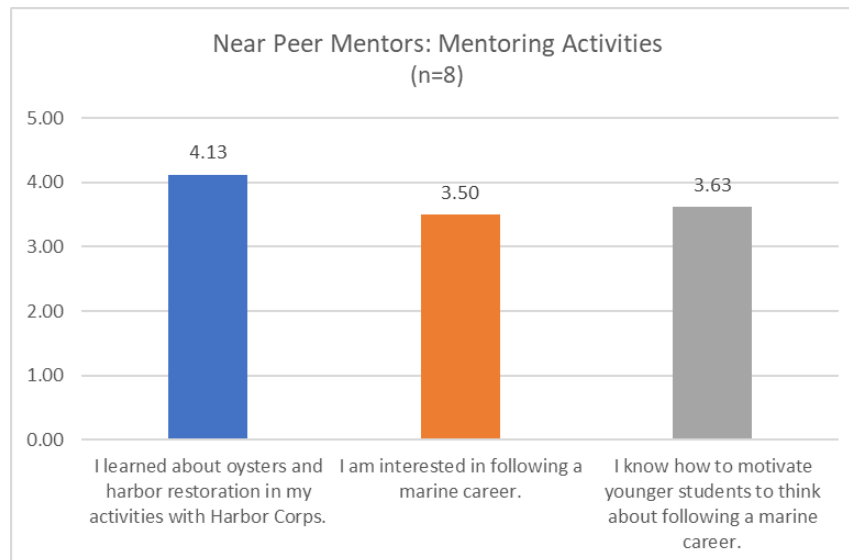
- Average responses to all three statements were positive to some extent with averages above 3 (Maybe).
- The highest average response was to the *statement I learned about oysters and harbor restoration in my activities with Harbor Corps* with an average of 4.13 (standard deviation=0.83).
- The lowest average was to the statement *I am interested in following a marine career* with an average of 3.50 (standard deviation=1.31).
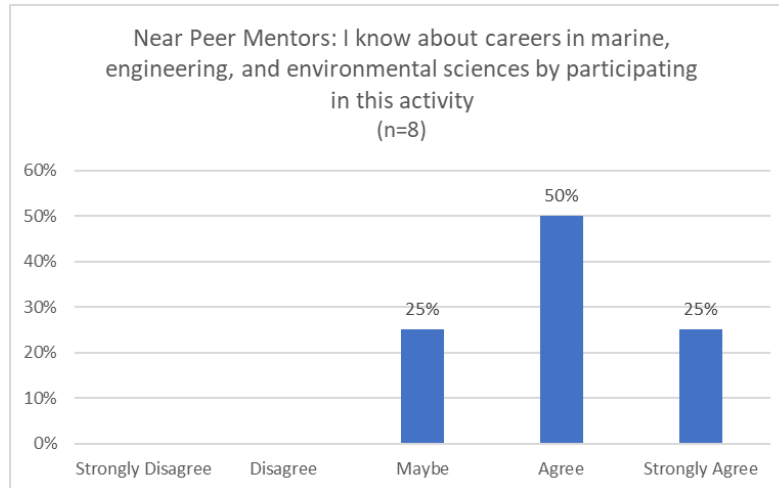
Student Mentors' Oyster Knowledge and Scientific Skills

Near Peer Mentors: Oyster Knowledge and Science Skills (n=8)

- Mentors in the Harbor High School near peer mentoring program had positive responses to both oyster knowledge and science skills statements.

The positive outcomes reflect that Harbor High School students have many opportunities to learn about oysters and use data collection and analysis skills. These very positive perceptions of their knowledge about oysters and use of science skills also make them good candidates to be mentors to younger students, especially as the mentoring program moves beyond high school mentees to middle school mentees which is planned for the future.

Student Mentors' STEM Career Knowledge

Near Peer Mentors: I know about careers in marine, engineering, and environmental sciences by participating in this activity (n=8)

- Seventy-five percent of mentors agreed to some extent that they learned about careers in marine, engineering, and environmental sciences through their participation in the near peer mentoring activities. As Harbor High School students, the mentors already learn about such careers, but they self-report learning even more through Harbor Corps and their mentoring experiences.

Student Mentors and Comparison Group

Harbor School Near Peer mentoring program participants' results were also compared with students who completed a survey but did not attend a BOP event during April-June 2021.
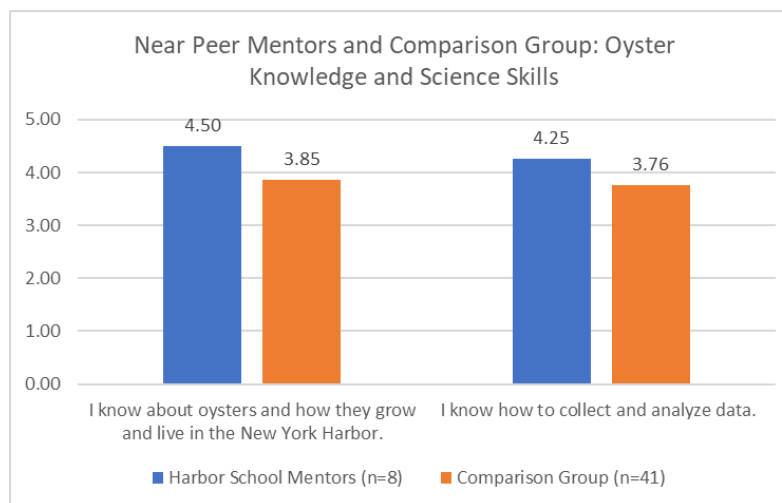
Near Peer Mentors and Comparison Group: Oyster Knowledge and Science Skills

- Harbor School near peer mentors reported higher average responses than students who did not have BOP involvement.
- The average response to *I know about oysters and how they grow and live in New York Harbor* was 0.65 point higher for mentors in the near peer mentoring program.

- The average response to *I know how to collect and analyze data* was 0.49 points higher for mentors.
- Unpaired t-tests were conducted on the mentor and comparison group responses. The results were statistically significant.

EVALUATION QUESTION 4. To what extent was the research effective in gathering evidence in answering the research questions and identifying the impacts of the program.

EFFECTIVENESS OF RESEARCH IN ANSWERING RESEARCH QUESTIONS
Challenges in Data Collection

The effectiveness of the research in answering the research questions and identifying the impact of the BOP CCRES project was circumscribed by challenges in data collection. In Year 4, researchers at The Mark encountered many obstacles in collecting complete responses to the *Student Research Survey*. The process, as designed by The Mark, of administering surveys and getting a fully completed survey and parental consent from each respondent was cumbersome, especially during the pandemic which limited access to students. Additions such as inserting color pictures into the survey in earlier iterations to make it more user friendly did not produce the expected results, nor had offering certificates for survey completion.

In regular, biweekly discussions from January to June 2021, BOP staff, researchers from The Mark, and evaluators from Gaylen Moore Program Evaluation Services explored solutions such as shortening and updating the survey, which by Year 4 included items that were no longer relevant, and providing IRB allowable incentives for completion. By mid-semester, the research group had shortened the survey, and streamlined the survey logic to make it easier to do the survey and obtain parent consent, as well as follow up with respondents to get parental consent. In addition, the entire BOP staff was enlisted to push harder to exhort students participating in the activities that proliferated in the spring semester to complete the survey.

Again, researchers and evaluators met biweekly starting in August 2021 to further streamline the survey process in preparation for administration in the fall 2021 semester. It was decided that The Mark would also prepare a paper survey that would be available for distribution to students at in-person events, as well as the electronic survey. By December 1, a total of 178 students had submitted a complete survey with parental consent, a large increase from previous years.

Evaluators also encountered challenges in collecting teacher survey data. Several factors were identified: 1) teachers were exhausted by the efforts of virtual teaching for the entire school year due to covid19, and had no bandwidth left to fill out surveys, two of which came at the end of the year when they were working with students to complete Symposium projects; 2) the master list of teacher participants has not been curated sufficiently to reflect the current participant list; and 3) there is a small, very dedicated and committed cadre of teachers who participated

enthusiastically in all BOP activities and completed surveys many times. These teachers were very satisfied and excited about the project's offerings, both for them and their students, as the data discussed earlier has shown. These teachers tended to recommend the BOP CCRES program to their colleagues. Plans to increase teacher survey response included inviting teachers to visit the BOP headquarters and oyster nursey at Governors Island, and schedule opportunities for teachers to meet in person at BOP CCRES social events, such as the BOP Mingle event held at Governors Island held in July 2021.

RESULTS OF RESEARCH TO ASSESS ACHIEVEMENT OF GOALS

Analyzing the student and teacher data collected in Year 4, evaluators and researchers were able to present findings that delivered evidence, presented in this report, that the BOP CCRES project met its goals to:
- sustain and augment the success of the BOP-CCRES Phase I project
- develop and expand programmatic offerings for teachers that increased student engagement and learning in oyster restoration research
- promote student awareness and interest in pursuing STEM careers

The research protocols and survey instruments established in Phase I, and modified in prior years of Phase II continued to be modified, including three iterations of the *Student Research Survey*, to more effectively assess the impact of the project on teachers' and students' skills in research and scientific investigation, and their awareness of marine-related STEM careers.

The research and evaluation data furnished evidence of the positive impact of the BOP CCRES project on teachers and its impact on students with some statistically significant outcomes to meet project goals. Teacher survey data has identified the strengths of the professional learning activities in modeling, preparing, and supporting teachers in engaging students in the Billion Oyster CCRES Project and to guide students in their own oyster restoration research, even instilling an interest in students to act as stewards of the environment. The benefits to teachers included: learning best instructional practices to develop students' research and scientific investigation skills; creating their own experiences in BOP of 'being a scientist'; and acquired ideas about how to relate students' research experiences with BOP to exploring possible STEM careers for themselves.

The student data enabled evaluators to identify statistically significant benefits for students as a result of the project's high quality professional development which contributed to promoting student engagement and learning related to research skills, but the project's impact on both teacher and student participants in building STEM career awareness and interest was less successful.

As outlined in Evaluation Question 1 above, the project continues to make progress in achieving this goal:
- further development of the BOP digital platform

In quarterly meetings, BOP staff informed evaluators and researchers of the progress made in developing the BOP CCRES digital platform and website. The work to expand and improve the platform to make it more user friendly for teachers was being done by BOP staff in collaboration with Fearless Solutions and Morgan Stanley consultants working pro bono to develop the oyster restoration data entry and data analysis aspects of project. Parts of the website and digital platform will go live in December 2021; the remaining components will go live in 2022. It is important to note that oyster restoration data collected and posted in BOP CCRES Phase I for the first version of the digital platform, and collected subsequently in Phase II was used consistently throughout Year 4, specifically in student research projects, to facilitate teacher and student learning and conducting research activities concerning oyster restoration in the New York Harbor.

CONCLUSION

RESULTS OF RESEARCH TO ASSESS ACHIEVEMENT OF BOP-CCRES GOALS & OBJECTIVES

Evaluators addressed four key evaluation questions in this report to assess the effectiveness of BOP CCRES in meeting its goals and achieving its objectives. Analyzing the data that was collected, evaluators and researchers were able to present findings that provided evidence presented in this report that the ITEST BOP-CCRES project met its objectives in: *1) promoting student engagement; 2) developing student interest in STEM content related to oyster science restoration; and 3) raising student awareness of STEM careers in marine and environmental sciences.*

The data shows a positive impact on teachers in their knowledge and engagement with oyster restoration content, and a positive impact on students in statistically significant outcomes on some parameters. Observations and teacher survey data has identified the strengths of the professional development activities in preparing and supporting teachers to engage students in the Billion Oyster Project and to guide students in their own oyster restoration research, even instilling an interest in being stewards of the environment. The teacher data also shows the impact of the project on teachers' capacity to promote student interest in STEM careers. Teachers learned practices, created their own experiences of 'being a scientist,' and acquired ideas about how to motivate students to pursue STEM careers.

The student data enabled evaluators to identify statistically significant benefits for students as a result of the high quality professional development provided by the project which contributed to promoting student engagement and learning related to scientific research skills, as well as developing student interest in STEM careers.

_____

How have the results been disseminated to communities of interest?

==TK: To date, evaluators and researchers have not disseminated their findings. (IS THIS TRUE, Cynthia?)==

PRODUCTS
The evaluator has produced annual and interim reports for the BOP-CCRES Projects in Phases I, II, and III.

PARTICIPANTS
What individuals have worked on the project?

Gaylen Moore   Senior Evaluator   Year 4
Sole Proprietor of Gaylen Moore Program Evaluation Services

Cara-Lynne Thomas   Research Assistant   Year 4

What other organizations have been involved as partners?
None.

Have other collaborators or contacts been involved?
No

IMPACTS

What is the impact on the development of the principal disciplines of the project?
Nothing to report.

What is the impact on other disciplines?
Nothing to Report.

What is the impact on the development of human resources?
The evaluation knowledge and skills of my Research Assistant have grown considerably over the five years she has been working with me on evaluations of the Billion Oyster Project CCRES Phases I, II, and III projects. She is more than ready to assume a Senior Researcher role in any evaluation.

What is the impact on institutional resources that form infrastructure?
Nothing to report.

What is the impact on information resources that form infrastructure?
Nothing to report.

What is the impact on technology transfer?
Nothing to report.

What is the impact on society beyond science and technology
Nothing to report.

CHANGES / PROBLEMS

Changes in approach and reasons for change
Nothing to report

Actual or anticipated problems or delays and actions or plans to resolve them.
Nothing to report

Changes that have a significant impact on expenditures
Nothing to report

Significant changes in use or care of human subjects
Nothing to report

Significant changes in use or care of biohazards
N/A

APPENDIX

BOP CCRES Evaluation Reports
2021

Gaylen Moore Program Evaluation Services

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Billion Oyster Project
Professional Learning Survey Results
***Spring 2021***

The Billion Oyster CCRES Project (BOP) offered professional learning activities for teachers and community scientists throughout the Spring 2021 school semester. Using programs modified during the previous year due to the ongoing COVID-19 pandemic, BOP facilitated a combination of remote and in-person professional learning sessions, as changing COVID-19 conditions allowed, from February through July 2021. Participants responded to a survey following each session. In total, evaluators received 49 responses. Out of these responses, 27 came from teachers or educators, and 22 were from community scientists.

TEACHER PROFESSIONAL LEARNING SURVEY RESULTS

Below are the responses from the 27 program participants who identified themselves as teachers or educators. The sessions were organized in the following five categories: *Oyster Research Station (ORS) Basic Training*, *Introduction to the Oyster Research Tank*, the *Inquiry from Anywhere* professional learning series, *Symposium Prep Sessions,* and *Lab Training for Teachers*. Evaluators reviewed results from these sessions in the following categories of teacher and student engagement: teacher engagement and learning, continuing teacher participation, teacher feedback, and student engagement and learning.
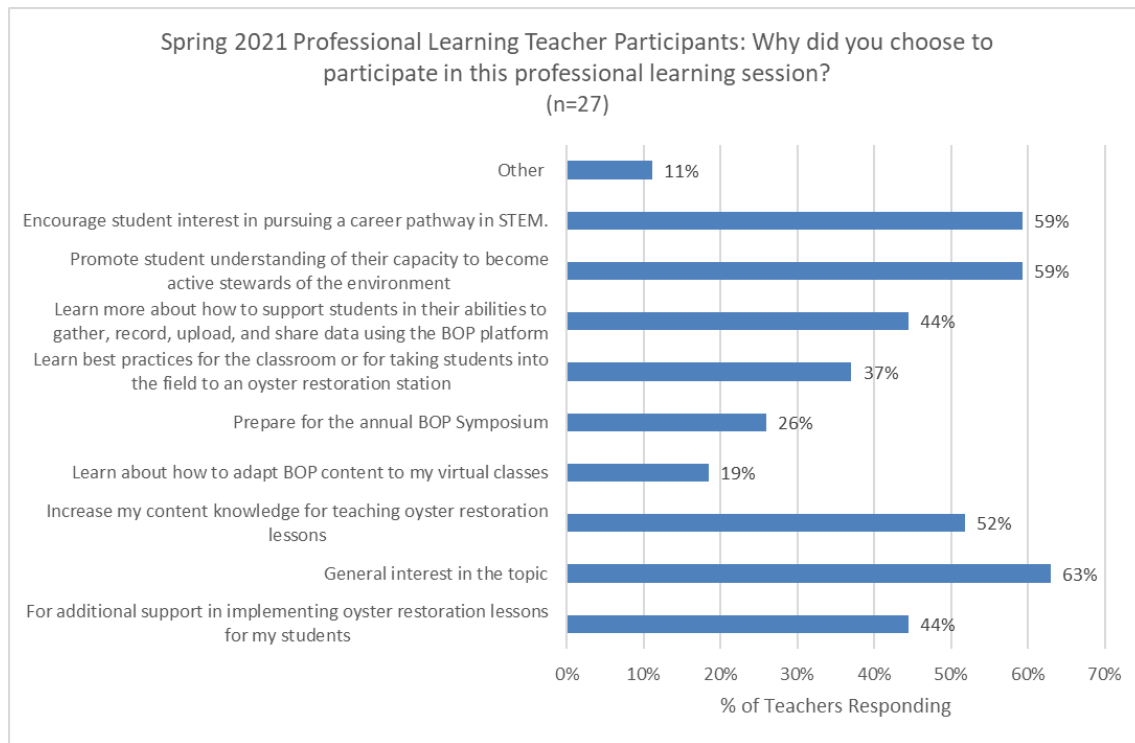
Overview of Respondents
Twenty-seven individual teachers responded to the survey. From these 27 teachers, at least 700 students may engage in BOP activities in their classes based on these workshops.

Spring 2021 Professional Learning Participants: Educator or Teacher Roles
(n=27)
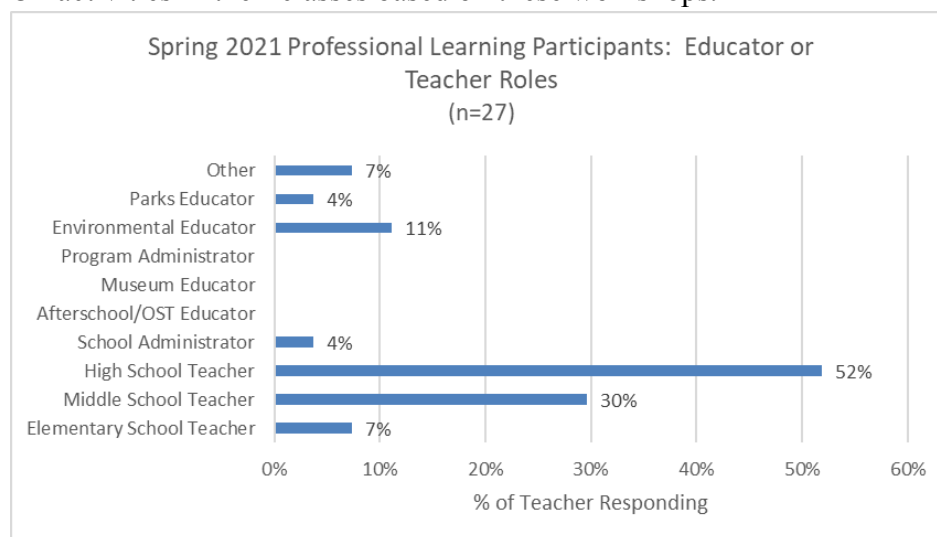
- Educator survey respondents held a range of roles during the 2020-21 school year.

- Fifty-two percent of respondents were high school teachers. This was the most frequent response.
- Eighty-nine percent of respondents reported being schoolteachers overall.
- Roles in the 'Other' category included:
  - Paraprofessional
  - College professor

Spring 2021 Professional Learning Teacher Participants: Why did you choose to participate in this professional learning session?
(n=27)

| Response	% of Teachers Responding
Other	11%
Encourage student interest in pursuing a career pathway in STEM.	59%
Promote student understanding of their capacity to become active stewards of the environment	59%
Learn more about how to support students in their abilities to gather, record, upload, and share data using the BOP platform	44%
Learn best practices for the classroom or for taking students into the field to an oyster restoration station	37%
Prepare for the annual BOP Symposium	26%
Learn about how to adapt BOP content to my virtual classes	19%
Increase my content knowledge for teaching oyster restoration lessons	52%
General interest in the topic	63%
For additional support in implementing oyster restoration lessons for my students	44%

- Teachers shared reasons they chose to participate in BOP professional learning sessions. They could select more than one response to this question. Across the surveys, the three highest responses were:
  - *General interest in the topic* with 63 percent
  - *Encourage student interest in pursuing a career pathway in STEM* with 59 percent
  - *Promote student understanding of their capacity to become active stewards of the environment* with 59 percent
  - These second two responses suggest that teachers are actively looking for ways to engage students in environmental activities and to encourage STEM careers and that they see BOP as a source for this content.
  - Responses in the 'Other' category included:
    - Meet other educators
    - Incorporate DNA analysis into current science curriculum
    - Introducing oyster tank in the classroom

After each session, teachers rated the professional learning session overall from 1 (Poor) to 6 (Excellent).

Spring 2021 Professional Learning Teacher Participants: Professional Learning Session Rating (n=27)
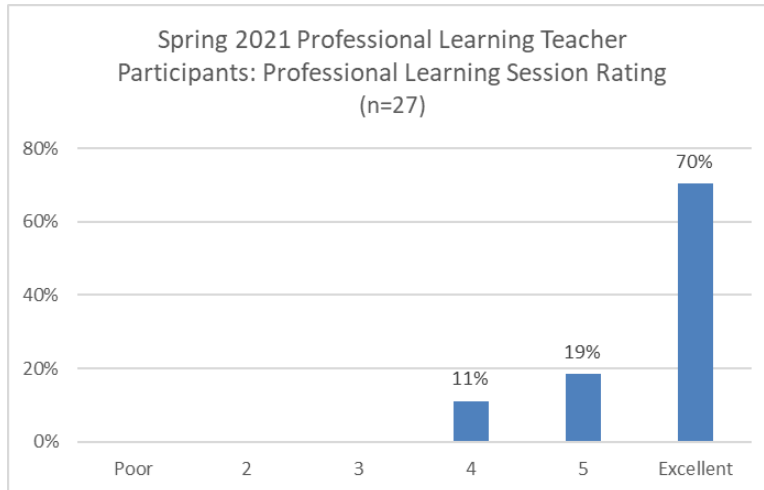
- All teachers rated their sessions positively to some degree.
- Seventy percent of teachers rated their session as 'Excellent,' suggesting that BOP is meeting their goal of providing high-quality professional learning opportunities to teachers.
- The average rating for all the sessions was 5.50.
  - Two session categories had the highest average rating at 6.00:
    - Symposium Prep
    - Introduction to Oyster Tank Training
  - The session category with the lowest average rating was the Inquiry Science series with an average rating of 5.00 (standard deviation=0.89)

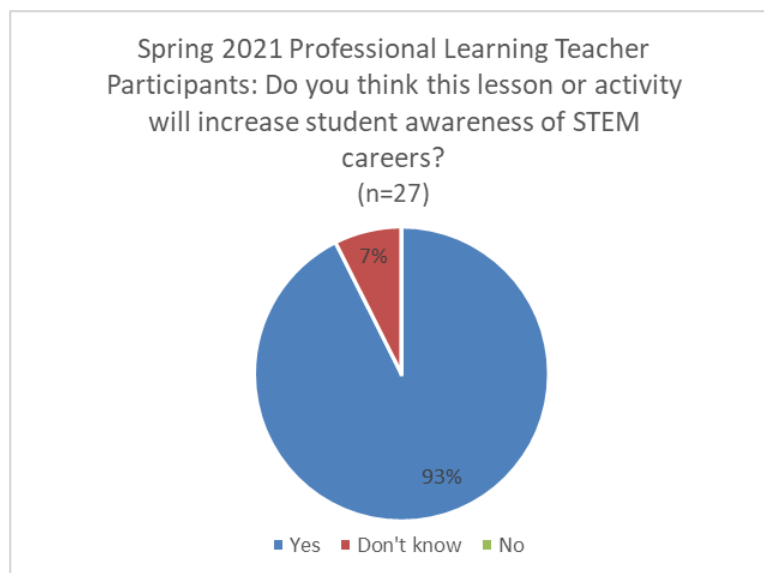Teachers were also asked if they plan to attend additional BOP professional learning sessions.

Spring 2021 Professional Learning Teacher Participants: Plan to Attend Another BOP PL Session (n=27)
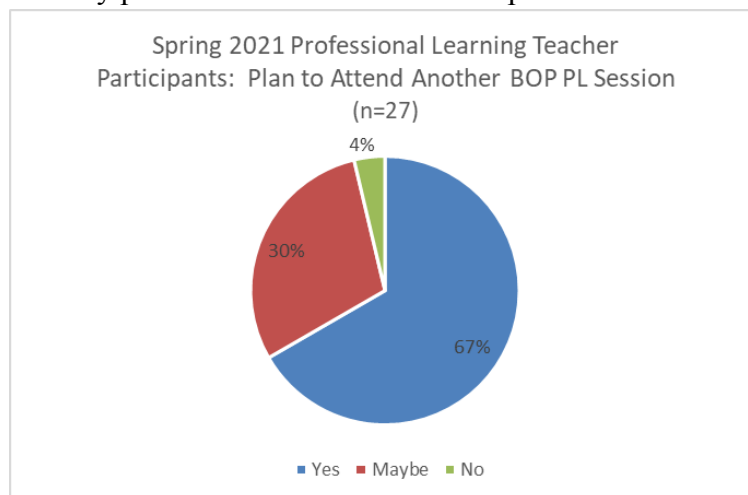
- Sixty-seven percent of respondents plan to attend another BOP professional learning event.
- Thirty percent said they 'maybe' would attend another.
- Four percent said they would not attend another BOP professional learning event.
- Factors in these responses are discussed in the sections on individual professional learning sessions.

Overall Student Engagement and Learning

Potential student engagement and learning is considered through several factors: whether teachers plan to use professional learning activities with students, whether they think the session they attended will increase student STEM career knowledge, and whether they plan to attend the annual BOP Symposium. Further factors in student engagement and learning are discussed in the individual session section below.


Spring 2021 Professional Learning Teacher Participants:
Plan to Use PL Activity with Students
(n=27)
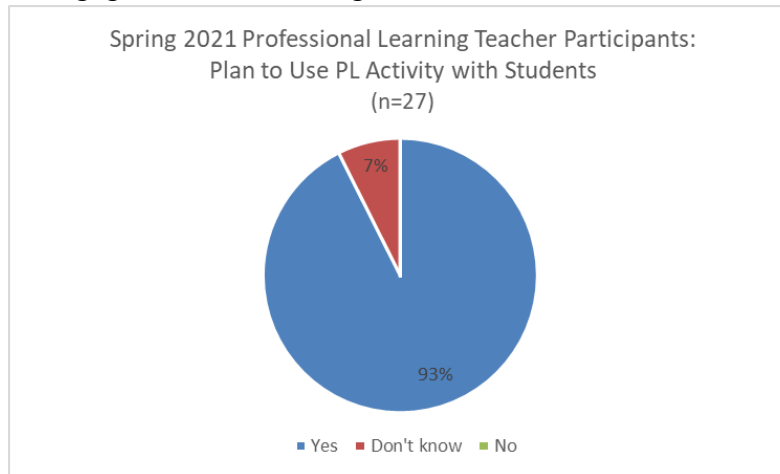
- Ninety-three percent of teacher respondents plan to use their professional learning activity with their students. This suggests that BOP is providing lessons, materials, and activities that are useful for teachers and that teachers think will engage their students.

Spring 2021 Professional Learning Teacher Participants: Do you think this lesson or activity will increase student awareness of STEM careers?
(n=27)

- Ninety-three percent of teachers thought that their BOP lesson or activity would increase student knowledge of STEM careers.
- This positive outcome combined with a majority of participants seeking out BOP activities because they are interested in student STEM career and environmental stewardship awareness can reinforce BOP's role as a resource for this.

At the end of the school year, Billion Oyster Project hosts an annual research symposium for students, teachers, and community scientists to share their research and learn about other research happening in the

New York Harbor and beyond. Thus, the Symposium is an opportunity for students to go deeper into scientific work, both their own and others'.
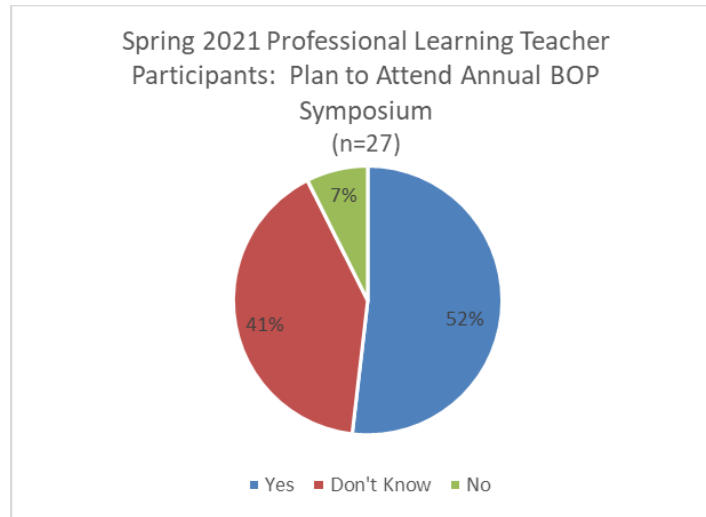
- Fifty-two percent of participants planned to attend the Annual BOP Symposium.
- Forty-one percent said they maybe would attend.
- Factors in attendance from individual events is discussed below.

OYSTER RESEARCH STATION (ORS) BASIC TRAINING

Evaluators received seven surveys from three sessions of Oyster Research Station (ORS) basic training workshops. This is approximately 23 percent of ORS basic training teacher participants. ORS basic training is an entry-level training to familiarize participants with BOP, harbor restoration, and collecting data through monitoring an ORS unit. ORS basic training consisted of two sessions one held virtually and one in-person. ORS training dates included in these results are: April 8, 2021, June 24, 2021, and June 25, 2021. For 57 percent of respondents, their ORS training was their first time participating in BOP programming.
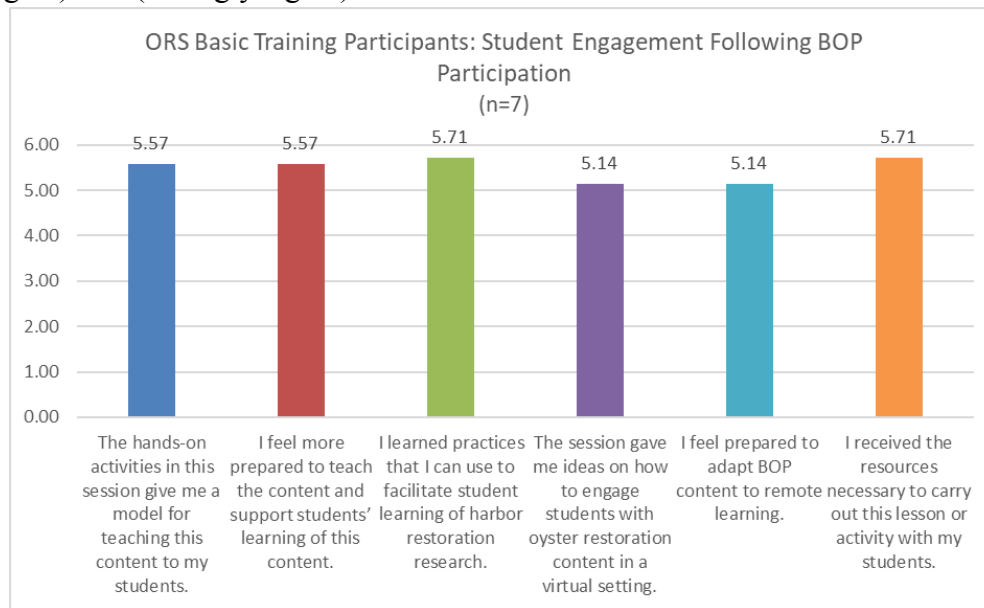
Student Engagement and Learning

Student engagement and learning was evaluated through teacher participants' intention to use activities from their BOP professional learning session(s) with their students, the ways they intend to use the activities, and what they learned from their session that can inform how they engage students with BOP activities and lessons.

All the respondents from ORS basic training plan to use their training with their students. Teachers plan to use the activities because they will give students hands-on scientific experience, and help them advocate for and learn about the environment of the NY Harbor. Ways teachers plan to use the activities with their students include:

- *Bring them to the oyster stations, use oysters to explain keystone species and food webs*
- *Project-based learning and data collection*
- *I plan to teach using the "Ecosystem Engineers" curriculum developed by BOP with all my classes. I would like to take a smaller group of interested students out regularly to collect data. I hope to be able to have students present research or other art/activism works for the symposium.*

Teachers responded to a series of statements about how they will engage with students based on what they learned from the professional learning session they attended. These statements were rated on a scale of 1 (Strongly Disagree) to 6 (Strongly Agree).


- Teachers' average responses to all student engagement statements were positive and fell between 5 (agree) and 6 (Strongly Agree).
- Two statements had the highest average response at 5.71 (standard deviation=0.49):
    - *I learned practices that I can use to facilitate student learning of harbor restoration research.*
    - *I received the resources necessary to carry out this lesson or activity with my students.*
- Two statements had the lowest average response at 5.14 (standard deviation=1.46):
    - *The session gave me ideas on how to engage students with oyster restoration content in a virtual setting.*
    - *I feel prepared to adapt BOP content to remote learning.*

High average responses to the survey and clear plans for ways to use ORS basic training materials with students suggests high potential for student engagement and learning.

Teacher Engagement and Learning
Teachers responded to a series of statements about what they learned from the professional learning session they attended. These statements were rated on a scale of 1 (Strongly Disagree) to 6 (Strongly Agree).

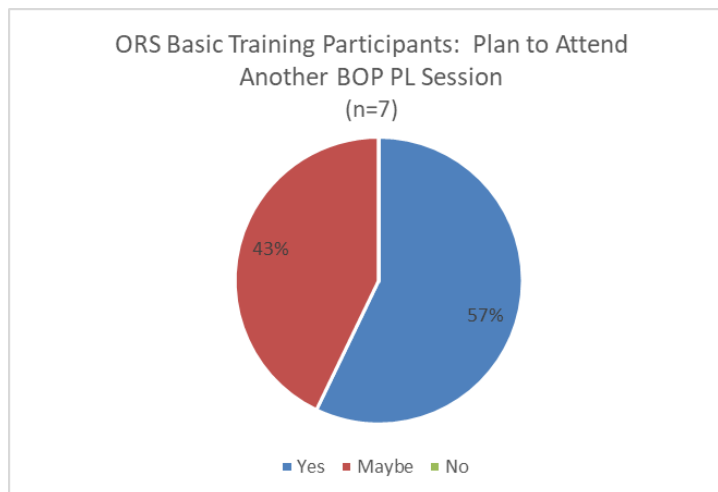ORS Basic Training Participants: Perceptions of Knowledge Following BOP Participation (n=7)
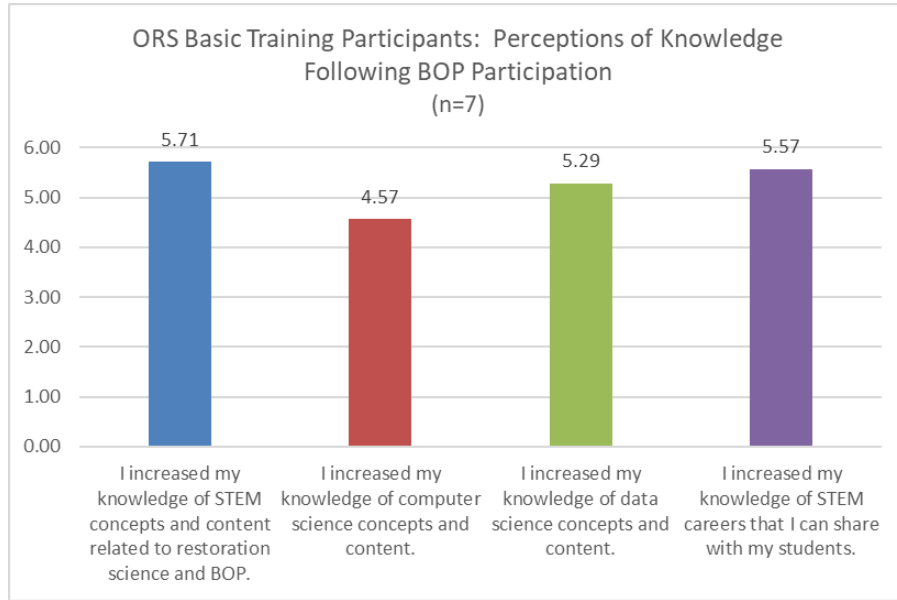
- The average responses to all statements were positive to some extent and were between 4 (Somewhat Agree) and 6 (Strongly Agree).
- The highest average response was to the statement *I increased my knowledge of STEM concepts and content related to restoration science and BOP* with an average of 5.71(standard deviation=0.49).
- The lowest average response was to the statement *I increased my knowledge of computer science concepts and content* with an average of 4.57(standard deviation=1.62).
    - Computer science is not a focus of this professional learning workshop, so the lower average is not surprising.
- Teachers were asked what could be changed about the training to better prepare teachers to use this material with their students. Feedback included:
    - *I would have liked to have Agata tell us about common misconceptions or mistakes that students might make out on the field trip measuring oyster growth.*
    - *Access to the PowerPoint slides (if possible)*
    - *I wish that the session was more interactive. It was more a lecture, and the only engagement was at the beginning with the introductions.*

Continuing Teacher Participation
Teachers' interest in continuing participation in BOP activities was evaluated by their plans to attend the annual BOP research symposium and to attend future BOP professional learning sessions.

ORS Basic Training Participants: Plan to Attend Annual BOP Symposium (n=7)

- Fifty-seven percent of ORS basic training respondents planned to attend the annual symposium.
- Some of the sessions were held after the 2021 Symposium, thus the next symposium is almost a year from the ORS session teachers attended. Additionally, over half of the ORS basic training respondents reported being first time participants and may not have had enough time to consider how the symposium fits into their plans for engaging their students.

ORS Basic Training Participants: Plan to Attend Another BOP PL Session (n=7)

- Fifty-seven percent of ORS basic training participants plan to attend another BOP professional learning sessions.
- Forty-three percent may attend another PL session.
- No one said they did not plan to attend another BOP professional learning session.
- When ask why they may or may not participate in the future, teachers gave the following feedback:
    - *I am not sure what other professional opportunities are available.*
    - *I am hoping to have students to participate in the symposium to share their research with a larger audience.*
    - *I hope to have interested students present work. It connects them to the community and real-world issues, and helps them take ownership of the work.*

Teacher Comments and Feedback
Teachers provided additional feedback on how the sessions could be improved:
- *It's hard to say without finishing the 2nd part of the session. There's a lot more I'm looking forward to doing with the hands-on part of the session. I appreciate that BOP shared the Ecosystem Engineers unit... it was very related to some of the things we briefly learned today (filtering, types of oyster habitats). I think it may be good to mention that unit resource in the session, in case other educators didn't know about it.*

SYMPOSIUM PREPARATION SESSIONS
Evaluators received eight responses from three dates of BOP Symposium prep sessions. This represents 53 percent of the teachers who participated in these sessions. The three sessions focused on different aspects of preparing students to present research at the annual BOP Research Symposium held in June 2021. Dates included in these results are: March 25, 2021, May 4, 2021, and May 11, 2021. For 13 percent of survey respondents, symposium preparation was their first time participating in BOP programming.
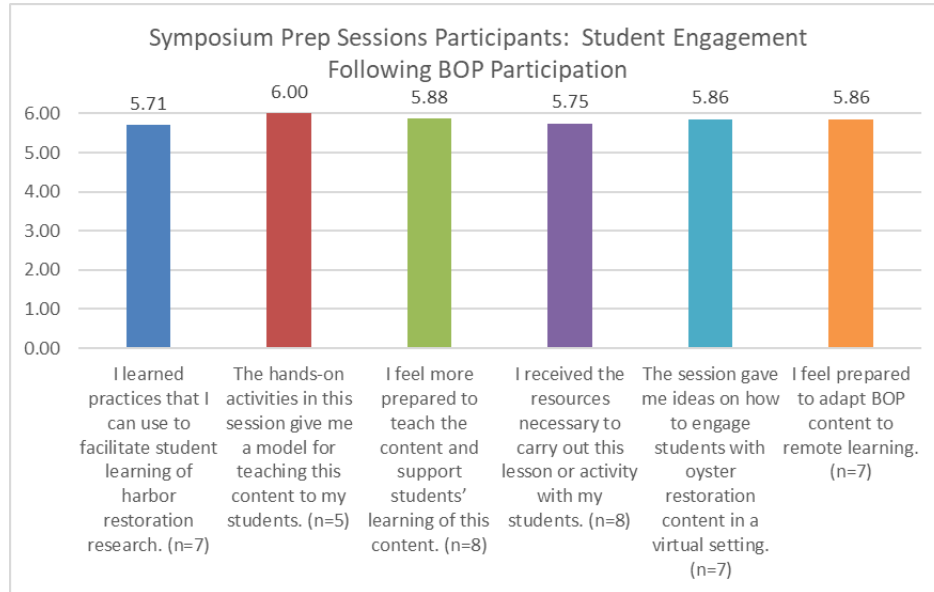
Student Engagement and Learning
Student engagement and learning was evaluated through teacher participants' intention to use activities from their BOP professional learning session(s) with their students, the ways they intend to use the activities, and what they learned from their session that can inform how they engage students with BOP activities and lessons.

All respondents from the Symposium Prep sessions plan to use the activities with their students. Teachers planned to use the activities with students because these sessions were specifically designed to help teachers who are working with students to develop symposium projects, and they received feedback on symposium projects and got ideas from BOP facilitators and peers to aid in student research and project design. More specific ways teachers plan to use the sessions include:
- *My students have analyzed the BOP oyster data using Google sheets, but the three students I focused on are stuck, and I needed help getting ideas on how to move them forward with their research. The other teachers / scientists at the event gave me feedback to have students work with each other, and to teach the data analysis in the framework of the scientific method. I will be using those two ideas and using the NYT's "What's Going On In This Graph" to move my students forward.*
- *We will look at data sets received and will look at different aspects of the data.*
- *Aim for next year's symposium and develop curriculum to scaffold up to that beginning fall 2021.*
- *Discuss with students about possible topics and other inspiration*

Teachers responded to a series of statements about how they will engage with students based on what they learned from the professional learning session they attended. These statements were rated on a scale of 1 (Strongly Disagree) to 6 (Strongly Agree). Note: for these statements, respondents also had the option "Not addressed in this session." Differences in n-values reflect those who selected "Not addressed."
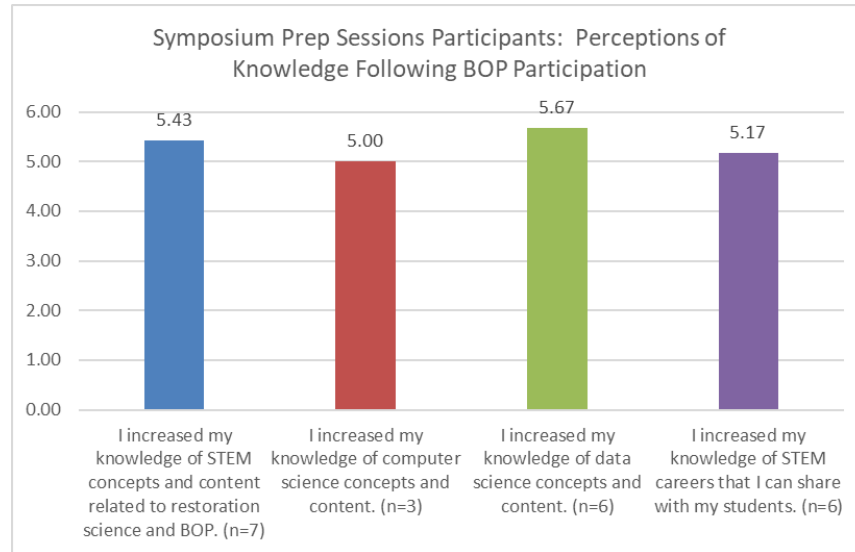
Symposium Prep Sessions Participants: Student Engagement Following BOP Participation

- Average responses from teachers at the Symposium Prep sessions related to student engagement where highly positive and between 5 (Agree) and 6 (Strongly Agree). These sessions may be particularly effective at engaging students. The teachers attending these sessions are also motivated toward learning about how to engage students in research.
- The highest average response was to the statement *The hands-on activities in this session give me a model for teaching this content to my students* with an average of 6.00; however, three respondents felt this statement was not applicable to their session.
- The lowest average was to the statement *I learned practices that I can use to facilitate student learning of harbor restoration research* with an average of 5.71 (standard deviation=0.49)

High average responses to the survey and clear plans for ways to use Symposium Prep materials with students suggests high potential for student engagement and learning.
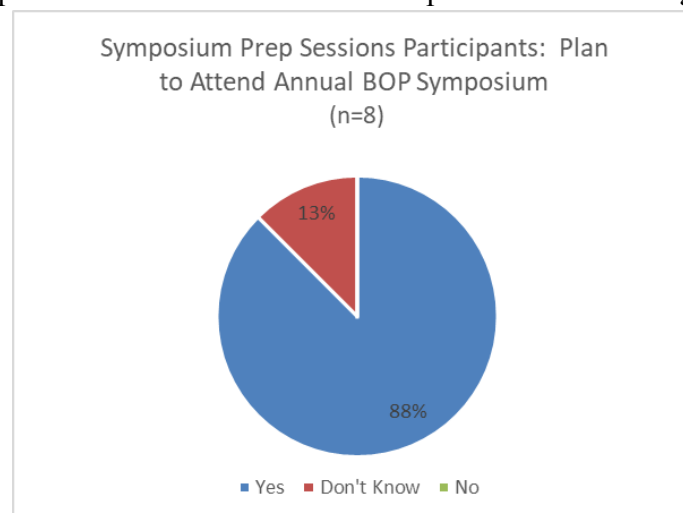
Teacher Engagement and Learning

Teachers responded to a series of statements about what they learned from the professional learning session they attended. These statements were rated on a scale of 1 (Strongly Disagree) to 6 (Strongly Agree). Note: or these statements, respondents also had the option "Not addressed in this session." Differences in n-values reflect those who selected "Not addressed."

Symposium Prep Sessions Participants: Perceptions of Knowledge Following BOP Participation

Bar chart values: 5.43, 5.00, 5.67, 5.17

Categories:
- I increased my knowledge of STEM concepts and content related to restoration science and BOP. (n=7)
- I increased my knowledge of computer science concepts and content. (n=3)
- I increased my knowledge of data science concepts and content. (n=6)
- I increased my knowledge of STEM careers that I can share with my students. (n=6)

- Average responses about teacher learning from the Symposium Prep sessions were positive and were between 5 (Agree) and 6 (Strongly Agree).
- The highest average response was to the statement *I increased my knowledge of data science concepts and content* with an average of 5.67 (standard deviation=0.52).
- The lowest average response was to the statement *I increased my knowledge of computer science concepts and content* with an average of 5.00 (standard deviation=1.00). This statement was marked 'Not Applicable' by five participants and was not an explicit focus of these sessions.
- Teachers were asked what could be changed about the training to better prepare teachers to use this material with their students. Only one response was received:
  - *We ran out of time at the end, but it would have been great to look at some former Symposium submissions for ideas. I haven't participated before so I will probably look at some stuff on my own time.*

Continuing Teacher Participation
Teachers' interest in continuing participation in BOP activities was evaluated by their plans to attend the annual BOP research symposium and to attend future BOP professional learning sessions.

Symposium Prep Sessions Participants: Plan to Attend Annual BOP Symposium (n=8)

Pie chart: Yes 88%, Don't Know 13%, No

- Eighty-eight percent of respondents planned to attend the annual BOP Symposium. This high participation rate is expected as preparing students to do research projects and present at the symposium is the goal of these sessions.
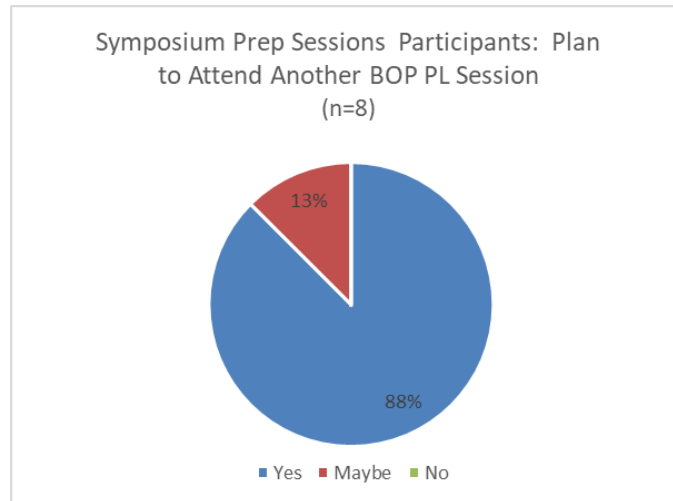
Symposium Prep Sessions Participants: Plan to Attend Another BOP PL Session (n=8)

13%

88%

■ Yes ■ Maybe ■ No

- Eighty-eight percent of respondents plan to attend another BOP professional learning session.
- Thirteen percent may participate in another session.
- Most of the participants in these sessions were previous BOP participants and were already engaged in BOP activities. When asked why they may or may not attend another BOP session responses included:
    - *It's been really helpful and has helped push my teaching career forward. I feel inspired to teach data analysis and ecology together, and to continue working with BOP in the future.*
    - *Time and sanity; it's been a long year*
    - *These sessions are always very effective and I learn a lot when attending.*
    - *I feel it's an important project and impacts our community and environment in wars that will positively effect change and strength in our students.*
    - *Learn more about how to inspire students towards research and how students can learn more about their surroundings*

Teacher Comments and Feedback
Teachers provided additional feedback on how the sessions could be improved. One response was received:

- *Consider adaptation for children with language-based disabilities (presenting could be a challenge)*

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### *Teacher Retrospective Survey Results*
2021

BACKGROUND
At the end of the 2020-21 school year, evaluators asked teachers who had participated in any Billion Oyster Project professional learning workshop or activities throughout the year to complete a retrospective survey. Teachers responded to questions about how they participated in BOP events, the ways in which BOP participation has impacted their teaching practice, whether they use BOP activities for student research, and ways BOP participation impacts student STEM career interest. In these ways, this survey looks at the larger impact of BOP professional learning sessions for teachers and their students and is more comprehensive than the survey teachers take immediately after their participation in BOP activities.

Retrospective Survey Respondents
The survey was sent to approximately 135 participants from BOP activities over the school year. Evaluators received 13 qualifying responses from K-12 teachers; some participants received the survey because they self-identified as a teacher or educator but were not K-12 teachers and did not qualify for the survey (evaluators received six responses from this group). Nineteen total responses is 14 percent of those who received the survey. Results from the 13 K-12 teacher surveys are presented below.

2020-21 Teacher Retrospective Survey: Grades Taught (n=13)
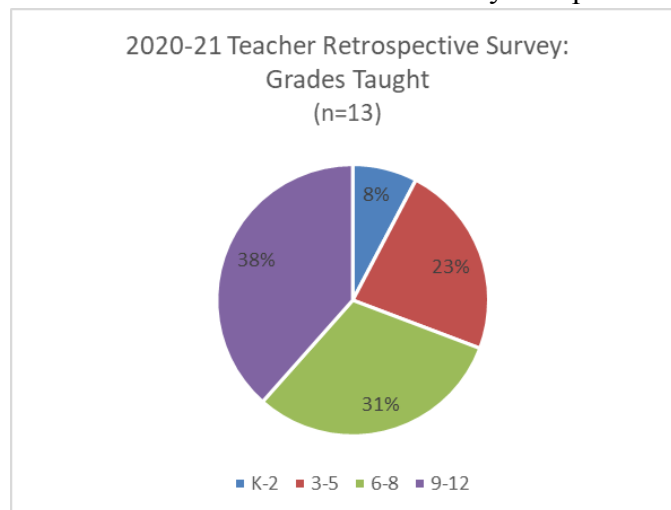
- Respondents taught across the whole K-12 grade range.
- Thirty-eight percent of respondents taught 9-12 grades during the 2020-21 school year. This was the most frequent grade level band reported on the survey.

2020-21 Teacher Retrospective Survey:
Number of Classes Taught
(n=13)
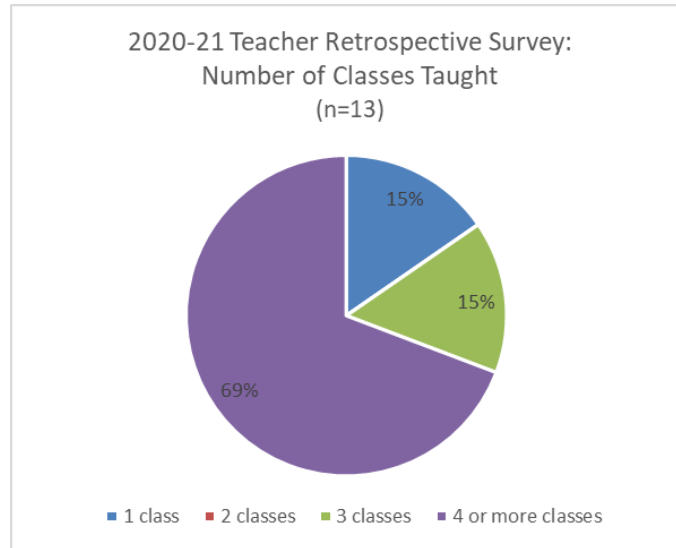
- Sixty-nine percent of respondents taught four or more classes during the 2020-21 school year. This was the most frequent response.
- Fifteen percent taught one class and another 15 percent taught three classes.

2020-21 Teacher Retrospective Survey: Average
Number of Students Per Class
(n=13)
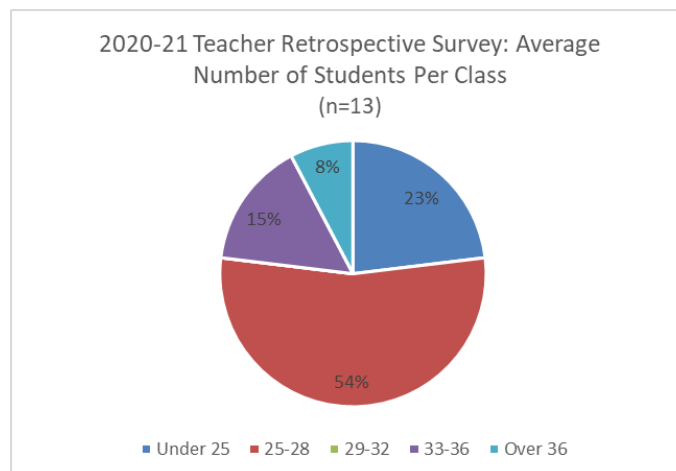
- Fifty-four percent of respondents had an average class size of 25 to 28 students.
- Twenty-three percent had an average class size below 25 students.
- Another 23 percent had an average class size of 33 students or higher.

2020-21 Teacher Retrospective Survey: Year Participated in BOP Activities (n=13)
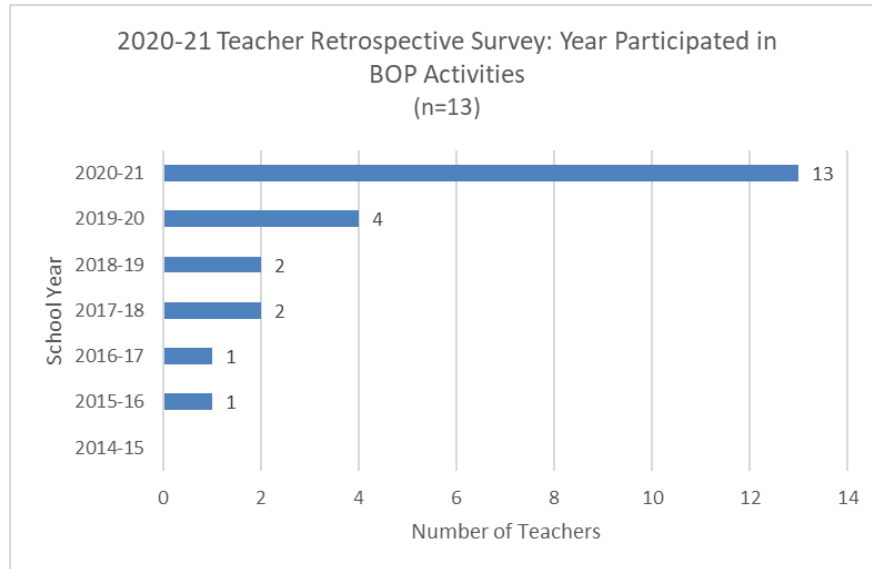
- While all respondents participated during the 2020-21 school year, four teachers had participated in BOP activities in previous years.
- Two teachers first participated last year, during the 2019-2020 school year.
- One teacher began participation in the 2017-18 school year.
- One teacher began participation in the 2015-16 school year.

2020-21 Teacher Retrospective Survey Respondents' BOP Activities (n=13)
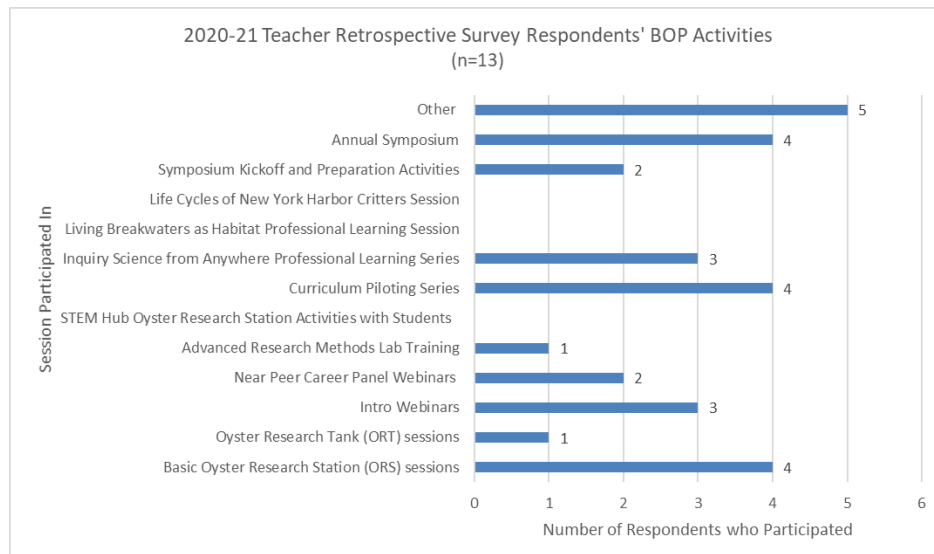
- Respondents attended a range of BOP events over the school year. Sixty-two percent of respondents reported attending more than one type of event during the 2020-21 school year.
- Four respondents each attended the following events:
  o The Annual BOP Symposium
  o The STEM+C Curriculum Pilot Program
  o Basic ORS Training
- No respondents attended the following events:
 o Life Cycles of New York Harbor Critters

- Living Breakwaters as Habitat
  - STEM Hub ORS activities with students
- Five respondents also attended other events:
  - Teacher Summer Mingle at Governor's Island (4 teachers)
  - Wild Oyster Survey Earth Day event (1 teacher)

**BOP Program Experience and Teaching Practice**

Teachers responded to a series of statements about different aspects of their experience in BOP activities and how their experience has impacted their teaching around oyster and waterfront restoration and use of student research. All statements were rated on a scale of 1 (Strongly Disagree) to 6 (Strongly Agree).
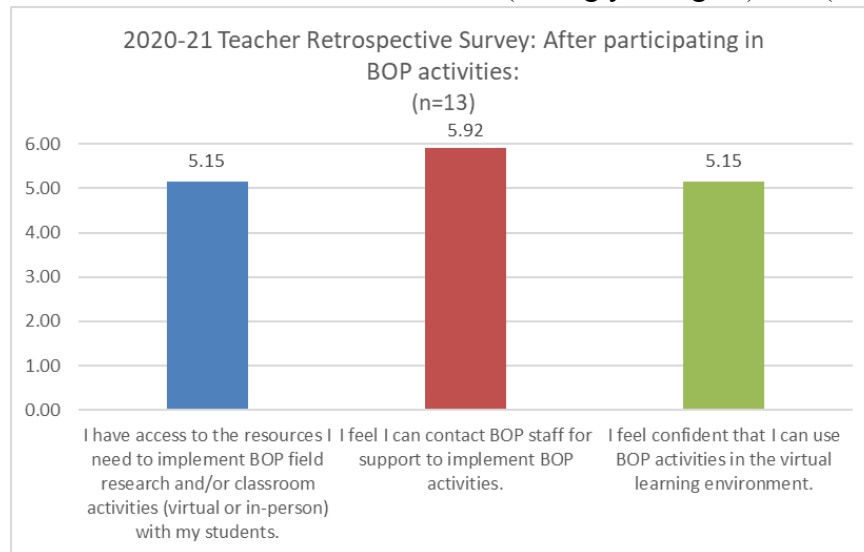
- Following participation in BOP activities, respondent felt positively about the support they received from BOP. Average responses to these statements all were between 5 (Agree) and 6 (Strongly Agree)
- The highest average response in this category was to the statement *I feel I can contact BOP staff for support to implement BOP activities* with an average of 5.92 (standard deviation=0.28).
- Two statements received an average of 5.15:
  - *I have access to the resources I need to implement BOP field research and/or classroom activities (virtual and/or in-person) with my students* (standard deviation=1.14).
  - *I feel confident that I can use BOP activities in the virtual learning environment* (standard deviation=1.41).
- High average responses in this category suggests that BOP staff has been successful in providing teachers with the resources and support they need to use BOP activities with their students and in pivoting workshops from an in-person model to virtual programming for both teachers and students.
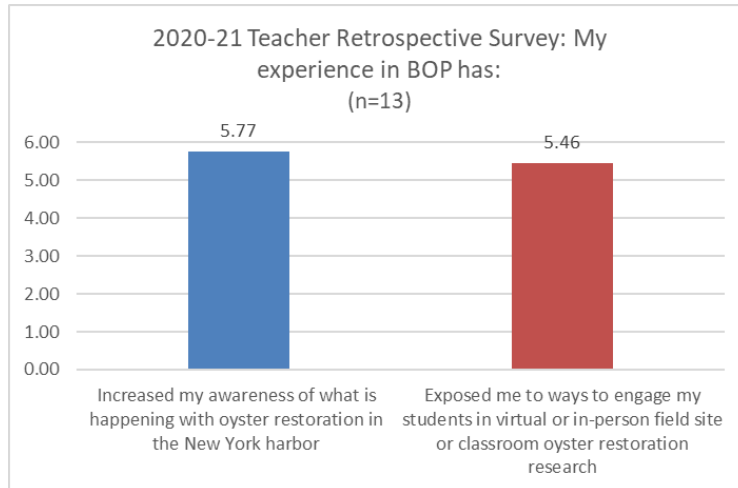
2020-21 Teacher Retrospective Survey: My experience in BOP has: (n=13)

- Teachers also responded positively to the impact of BOP in their understanding of oyster restoration, with average responses between 5 (Agree) and 6 (Strongly Agree).
- The statement *My experience in BOP has increased my awareness of what is happening with oyster restoration in the New York Harbor* received an average response of 5.77 (standard deviation=0.44).
- The statement *My experience in BOP had exposed me to ways to engage my students in virtual or in-person field site or classroom oyster restoration research* received an average response of 5.46 (standard deviation=1.13).
- These responses suggest that BOP had provided teachers with a range of ways to engage students and met one of their primary goals in raising awareness of oyster restoration in the NY Harbor.

2020-21 Teacher Retrospective Survey: I used the experiences from BOP activities to:
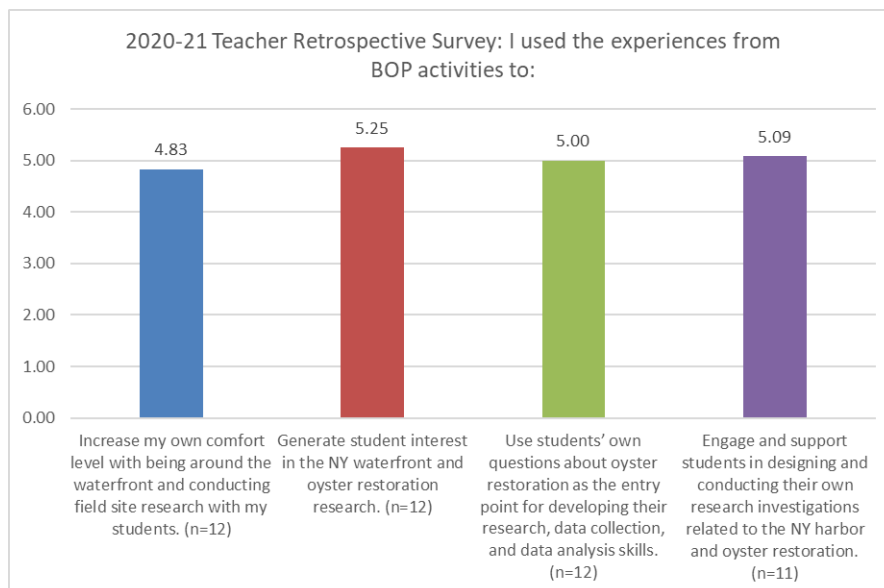
- A third category of questions focused on using BOP experience to conduct research with students. Responses to these statements, while still positive, were lower than others. Average responses to these statements mostly were close to 5 (Agree).

- Response numbers also varied on these statements. One teacher described the first three statements in this category as "not applicable to my BOP activities" and two described the fourth statement as not applicable.
- The statement with the highest average response was *I used the experiences from BOP activities to generate student interest in the NY waterfront and oyster restoration research* with an average of 5.25 (standard deviation=1.14).
- The statement with the lowest average response was *I used the experiences from BOP activities to increase my own comfort level with being around the waterfront and conducting field site research with my students* with an average of 4.83 (standard deviation=1.34).
  - This lower response may reflect that with the COVID-19 pandemic more teachers focused on activities that could be done from anywhere and with fewer specialized materials and less on in-person activities, especially activities that required leaving school campuses.

Teachers were also asked what could improve their experience in BOP activities. Feedback included:
- *Great to visit HQ and all there is present on the [Governor's] island!*
- *I'm interested in a couple print/digital tools to go along with identifying organisms at an ORS. We used the ecosystem engineers curriculum, but I couldn't find animal "cards" to go with the food web lessons, and today I saw a bingo organism game on the dock. Are these available somewhere?*
- *Continue PD Workshops for educators and integration of STEAM In curriculum.*
- *BOP in person again!*

Using BOP for Student Research
The Annual BOP Symposium is an opportunity for students to present research projects on NY Harbor restoration. Many BOP workshops include ways to extend beyond individual activities for students to do their own research that can be included at the annual event.

2020-21 Teacher Retrospective Survey: Students Did Own Oyster Restoration Research Projects (n=13)
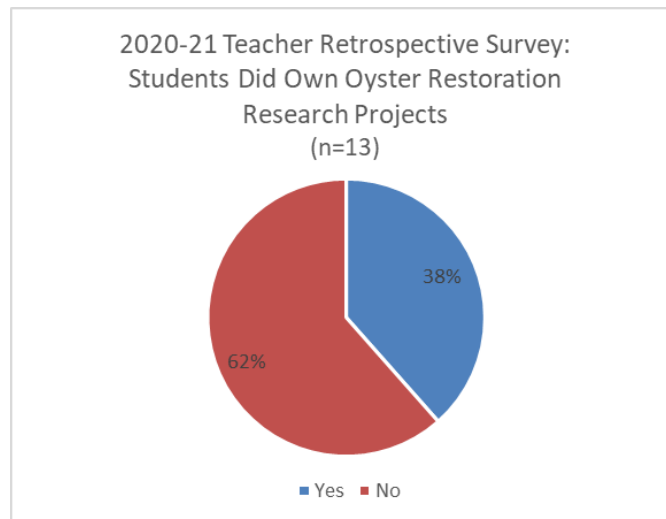
- Thirty-eight percent of respondents reported that students did their own oyster restoration research projects. Among those who reported doing research projects, one teacher had elementary age students, one had middle school grades, and three had high school grade students.
- Sixty-two percent did not engage students in their own oyster restoration research projects.

- Among those who did their own research projects, 40 percent (2 out of 5 teachers) reported that they presented at the virtual BOP symposium. The high school teachers' students did not present at the symposium. This may reflect that those students have other opportunities to present research.
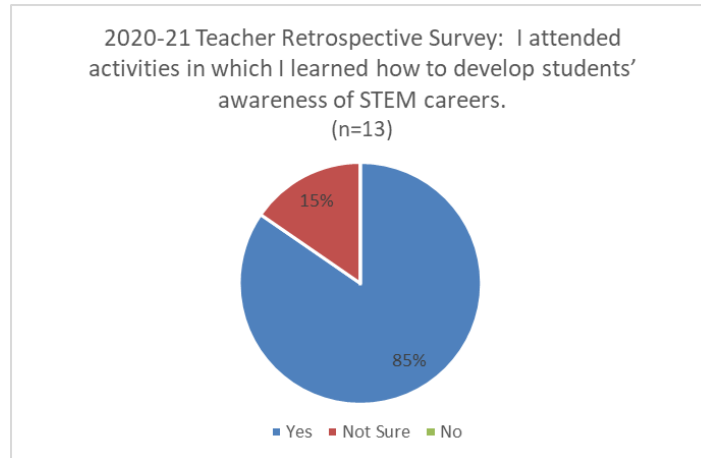
Those who reported students doing their own oyster research projects were asked how BOP materials and data were used in that research. Teachers could select multiple sources of information.

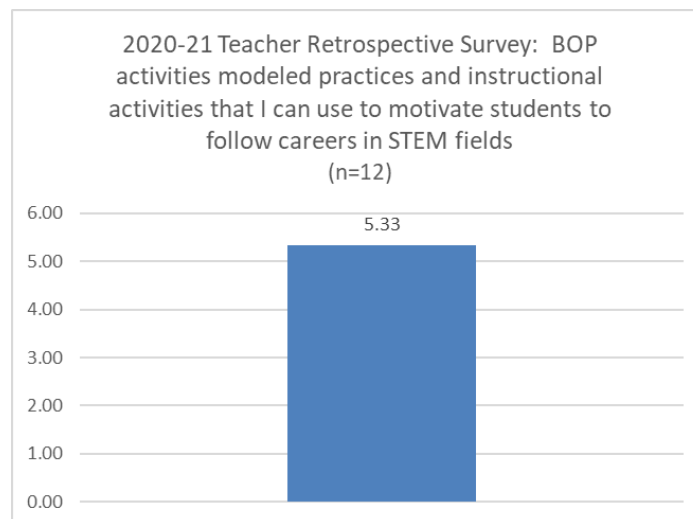2020-21 Teacher Retrospective Survey: Sources for Student Research Reported by Teachers (n=5)
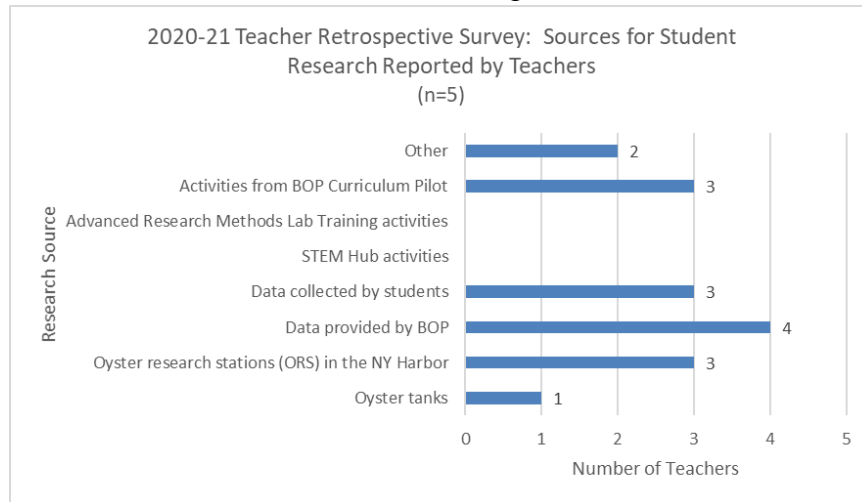
- Four teachers reported using data provided by BOP in their students' research.
- No teachers reported using:
  - Advanced Research Lab training activities
  - STEM Hub activities
    - While no teachers from this survey reported using official STEM Hub activities, three did report using ORS data.
- Two teachers used other sources of data and research for their students:
  - *Eel Mop installation in JC, Morris Canal*
  - *previous year's BOP professional development including engineering and design and the ROV with John Paul, also the plankton studies with the River Project*

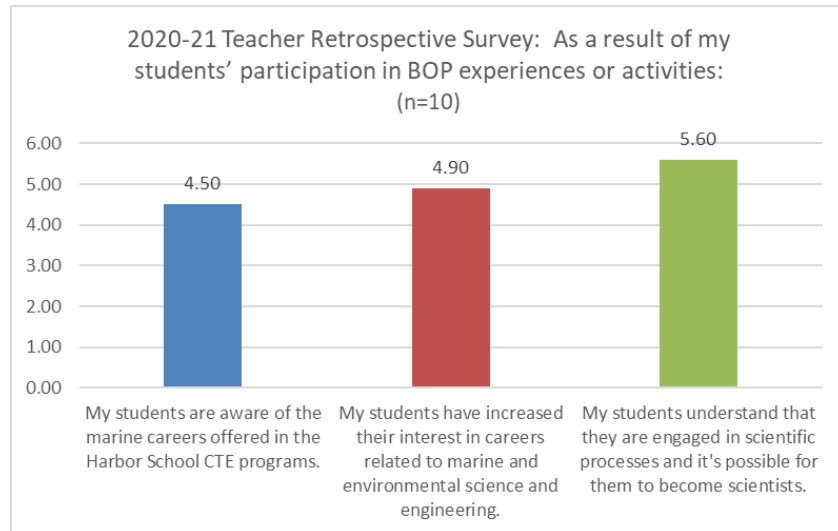### *Teacher Perspectives on Student STEM Career Knowledge and Interest*
One other goal of BOP activities is for teachers to be able to engage students in learning more about a range of marine STEM careers and build interest in those careers.

2020-21 Teacher Retrospective Survey: I attended activities in which I learned how to develop students' awareness of STEM careers. (n=13)

- Eighty-five percent of respondents attended activities where they learned how to develop students' awareness of STEM careers.
- Among the two teachers who responded 'not sure,' one reported teaching grades K-2. The other reported teaching grades 9-12.
  - One teacher who was 'not sure' did not answer the questions in the following section.

2020-21 Teacher Retrospective Survey: BOP activities modeled practices and instructional activities that I can use to motivate students to follow careers in STEM fields (n=12)

- One aspect of BOP trainings is that staff not only provide teachers with activities they can use in their classrooms, they also model how to use materials and lessons with students.
- The average response to the statement *BOP activities modeled practices and instructional activities that I can use to motivate students to follow careers in STEM fields* was positive at 5.33 (standard deviation=0.65).

2020-21 Teacher Retrospective Survey: As a result of my students' participation in BOP experiences or activities: (n=10)

- Responses to STEM career awareness and interest were mixed, but still positive overall.
- The highest average response was to the statement *As a result of my students' participation in BOP experiences or activities, my students understand that they are engaged in scientific processes and it's possible for them to become scientists* with an average of 5.60 (standard deviation=0.70).
  - Two teachers who attended an event after the school year had ended responded that this statement was 'Not Applicable.'
- The lowest average response was to the statement *As a result of my students' participation in BOP experiences or activities, my students are aware of the marine careers offered in the Harbor School CTE programs* with an average of 4.50 (standard deviation=1.43).
  - While marine science careers may be mentioned in a wide range of BOP activities, the Harbor School CTE programs may not be mentioned by name.
- Two elementary school grade teachers responded 'Don't Know' to the first two statements in this category. This response makes sense as younger students developmentally understand the idea of a job or career very differently than older students.

CONCLUSIONS

Teachers who participated in the 2020-21 Retrospective survey attended a range of BOP activities during the school year. Participants reported positive experiences both in BOP sessions and in using BOP lessons and activities in their classrooms. All respondents use BOP as a way to teach students about harbor restoration and some use it as an entry to students own scientific research. The majority of respondents thought that BOP activities connected to teachers' abilities to develop students' interest in STEM careers, although what that means varies by grade level and teacher experience. All around teachers had a positive and impactful experience with Billion Oyster Project.

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STEM Hub and Near-Peer Mentoring Activities
Student Research Survey Results
2021

Following Billion Oyster Project Pillar 1: STEM Hub activities and Pillar 2: Near Peer Career Panels, students had the opportunity to take an evaluation survey about their perceptions of their scientific skills and STEM career knowledge; this survey was part of a larger research survey. Students who acted as mentors in a near peer mentoring program at the Harbor School also took this survey near the end of the school year and responded to questions about their experience as a mentor.

Evaluation Notes
Results are presented in two sections: January-March 2021 and April-July 2021. In April, the survey was briefly taken offline and revamped to streamline the experience for students and make it easier for them to complete the survey. While the goals of the questions remained the same, the wording and answer choice changed. Participation in BOP programming was established by correlating the date of Billion Oyster Project student events to the date when surveys were started. Surveys started within a week of an event were considered participant surveys.

PILLAR 1: STEM HUB ACTIVITIES PARTICIPANTS - JANUARY-MARCH 2021

Evaluators identified 20 students who had attended STEM Hub events from January-March 2021.
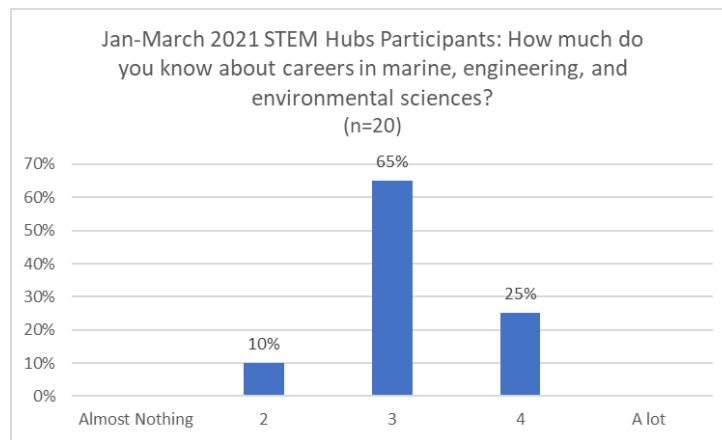
Perceptions of Science Skills
Survey questions were answered on a scale of 1 to 5, which 1 being the most negative and 5 being the most positive.

Jan-March 2021 STEM Hub Participants: Perceptions of Scientific Skills (n=20)
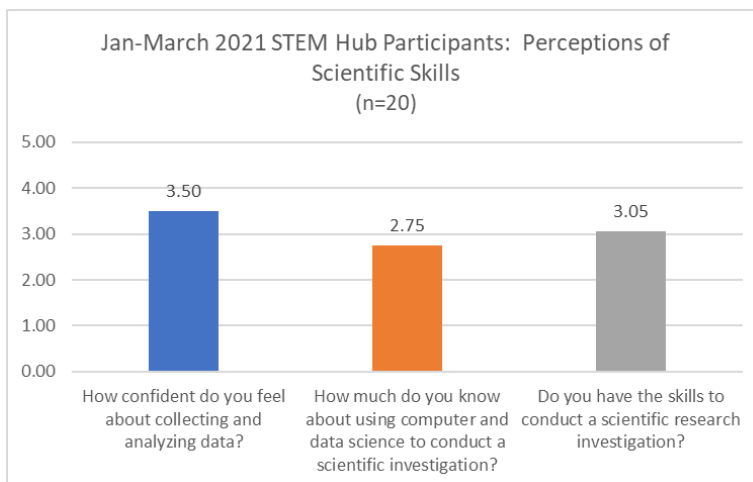
- The most positive response was to the question *How confident do you feel about collecting and analyzing data?* with an average response was 3.50 (standard deviation=0.89). On average, students report having some confidence in collecting and analyzing data.
- The least positive response was to the question *How much do you know about using computer and data science to conduct a scientific investigation?* with an average of 2.75 (standard deviation=1.07).
- STEM Hub activities focus on harbor restoration and data collection through testing and observation in the field. These activities do not utilize computer science skills.

STEM Career Knowledge

Students also responded to a question about their knowledge of STEM careers connected to harbor restoration and environmental science. Students responded on a scale of 1 (Almost Nothing) to 5 (A lot)

Jan-March 2021 STEM Hubs Participants: How much do you know about careers in marine, engineering, and environmental sciences? (n=20)
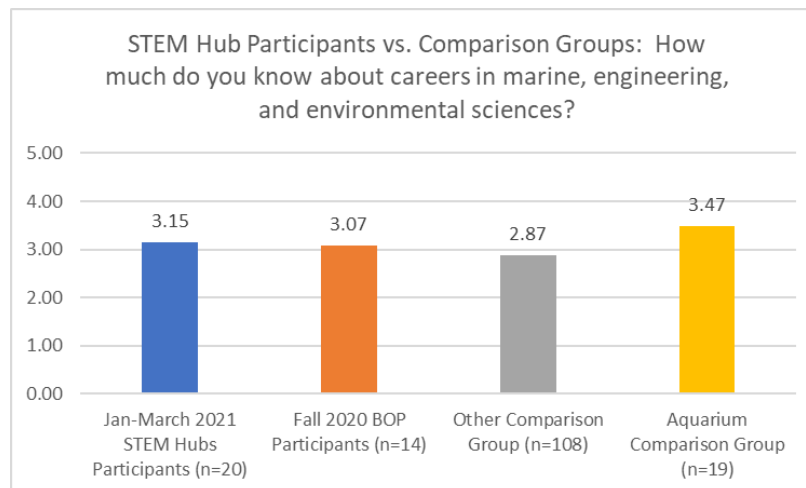
- The average response to STEM career awareness was 3.15.
- Sixty-five percent of students responded in the middle of the scale that they know some about these careers.

STEM Hubs and Comparison Groups

January-March STEM Hub participants' responses were compared to three groups of students: STEM Hub participants from the Fall 2020 semester, students from Fall 2020 who completed a survey but had no experience with BOP or another science organization, and a group of students who participated in New York Aquarium programming.

STEM Hub Participants vs Comparison Group: Perceptions of Scientific Skills
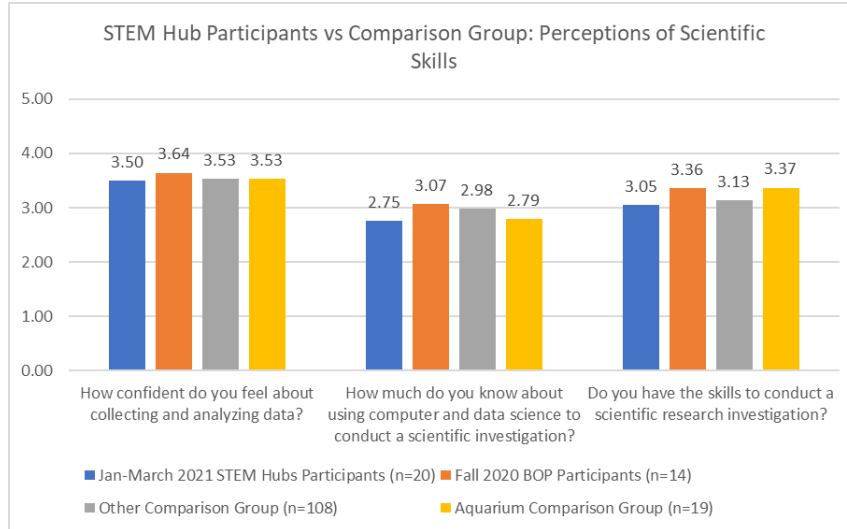
- January-March STEM Hub participants had lower average responses to all scientific skills questions than the participants from Fall 2020.
- Participants' responses were similar to or slightly lower than students who had not participated in the STEM Hub activities.

STEM Hub Participants vs. Comparison Groups: How much do you know about careers in marine, engineering, and environmental sciences?
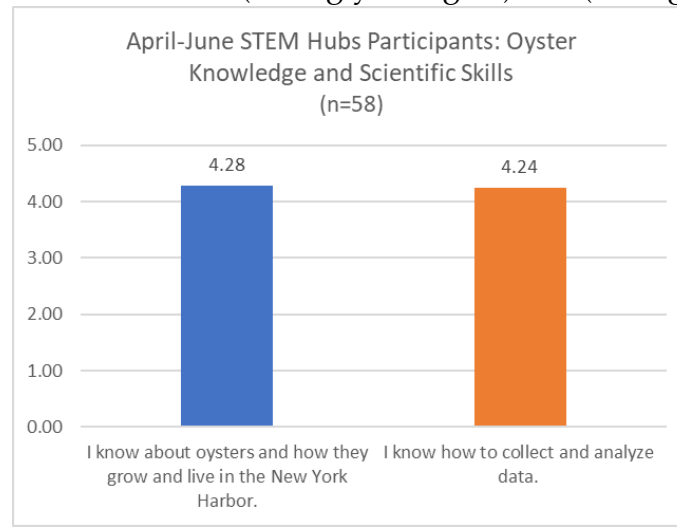
- January-March STEM Hub participants felt more positively about their STEM career knowledge than the Fall 2020 participants and the general comparison group. They responded less positively than the NY Aquarium students.

STEM Hub Activities - April-July 2021

In April 2021, BOP staff and evaluators worked together to revise the student evaluation survey. Questions were changed to more closely align to BOP events in which students were participating and to make the survey process easier for students. Evaluators identified 58 students who participated in STEM Hub activities from April-June that took the student evaluation survey.

Oyster Knowledge and Scientific Skills

In the new survey, student responded to statements about oyster knowledge and scientific skills. All statements were rated on a scale of 1 (Strongly Disagree) to 5 (Strongly Agree).

- STEM Hub participants' average responses to both statements were positive and were between 4 (Agree) and 5 (Strongly Agree).
- *I know about oysters and how they grow and live in the New York Harbor* had an average response of 4.28 (standard deviation=0.67)
- *I know how to collect and analyze data* had an average response of 4.24 (standard deviation=0.68).
  - For students taking the Jan-March version of the survey, the statement about collecting and analyzing data received the most positive response.

STEM Career Knowledge
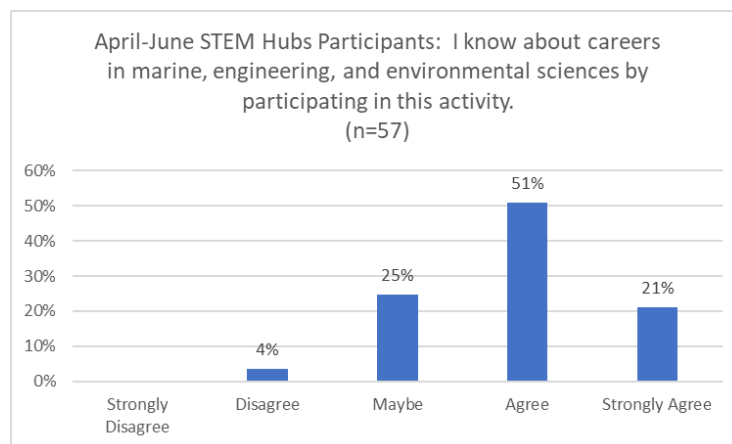
- The average response to STEM career knowledge for April-June STEM Hub participants was 3.89.
- Seventy-two percent of respondents agreed to some extent with the statement *I know about careers in marine, engineering, and environmental sciences by participating in this activity.*

     o   This statement was changed to make it more specific to the activity which students attended before taking the survey in order to make responses clearer.

STEM Hub Activities and Comparison Groups

Evaluators compared STEM Hub participant surveys to surveys from students who took the student evaluation survey from April-July but could not be connected to participation in a BOP activity.
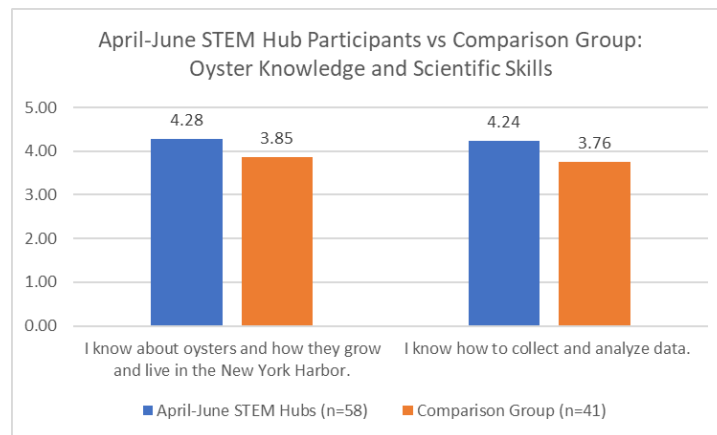
- STEM Hub participants reported knowing more about oysters than the comparison group. The average response was 0.43 higher.
- STEM Hub participants' average response to the *statement I know how to collect and analyze data* was more positive than the comparison group by 0.48 points.
- Unpaired t-tests were performed. These results were statistically significant.
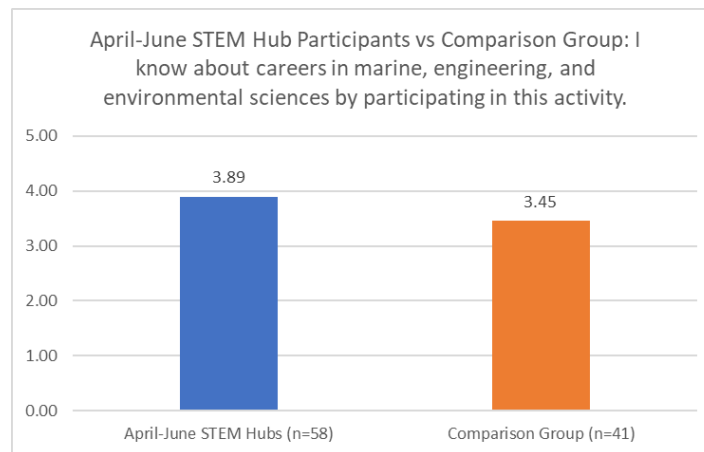
- STEM Hub participants reported more marine, engineering, and environmental science career knowledge than the comparison group. The average response was 0.44 points higher.
- Unpaired t-test were conducted on the results for the STEM Hub participants and the control group. The results were statistically significant.
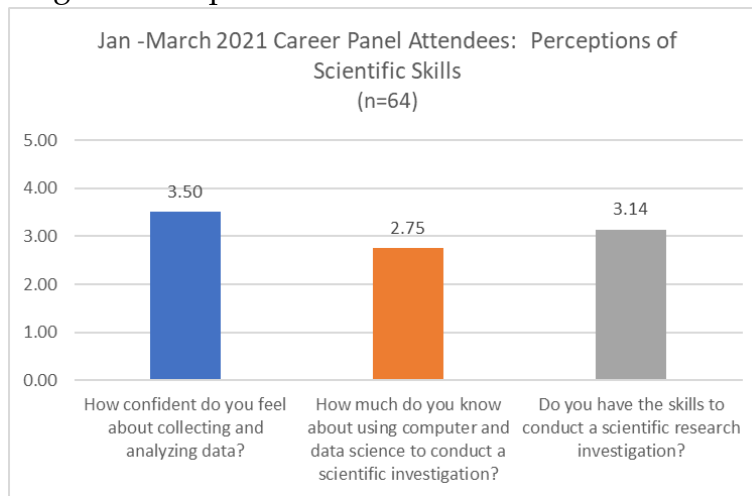
PILLAR 2: NEAR PEER MENTORING ACTIVITIES
Career Panels

During the Spring 2021 semester, Billion Oyster Project ran career panels moderated by Harbor School students that focused on one of the marine STEM tracks featured at the Harbor School. Panelists included Harbor School alumni and others who worked in jobs related to those tracks. Students who attended those programs responded to the student evaluation survey.
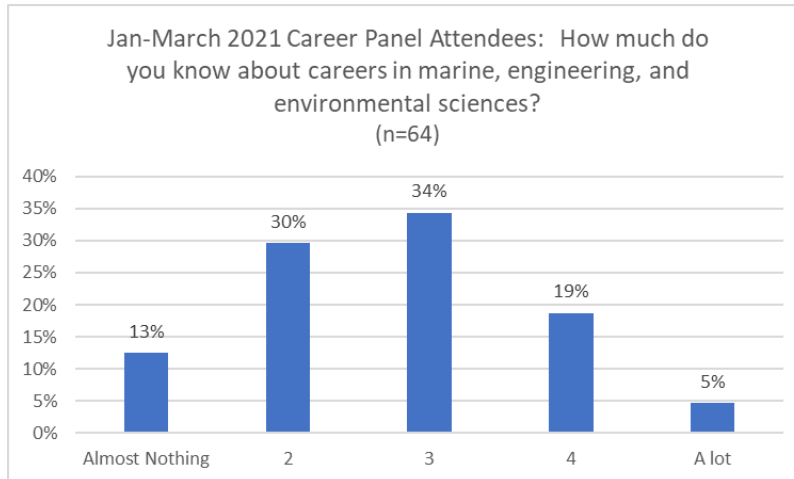
Perceptions of Scientific Skills
Evaluators identified 64 students who had attended Near Peer Career Panel events from January-March 2021. Survey questions were answered on a scale of 1 to 5, which 1 being the most negative and 5 being the most positive.

Jan -March 2021 Career Panel Attendees: Perceptions of Scientific Skills (n=64)

- The highest average response was to the question *How confident do you feel about collecting and analyzing data?* with an average response of 3.50 (standard deviation=0.93). Students have some confidence in collecting and analyzing data.
- The lowest average response was to the question *How much do you know about using computer and data science to conduct a scientific investigation?* with an average response of 2.75 (standard deviation=1.05). Building computer and data science skills was not a focus of these panels.
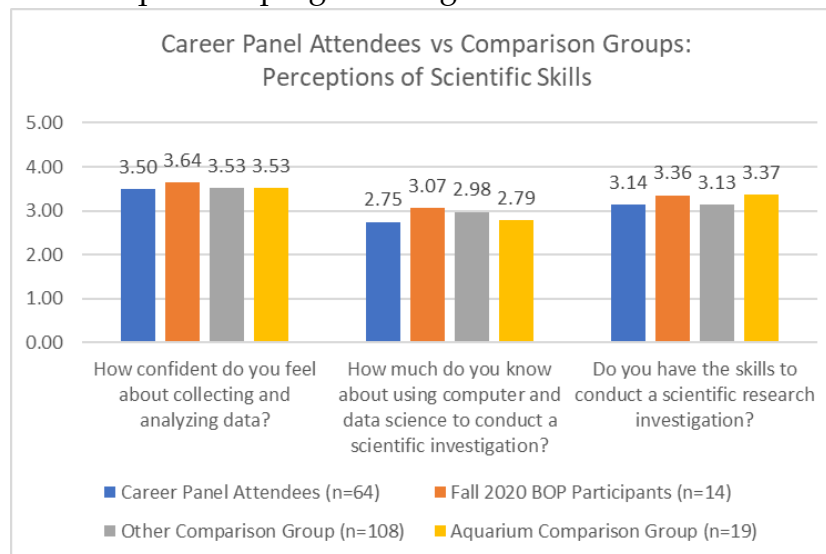
STEM Career Knowledge
Students also responded to a question about their knowledge of STEM careers connected to harbor restoration and environmental science. Students responded on a scale of 1 (Almost Nothing) to 5 (A lot)

Jan-March 2021 Career Panel Attendees: How much do you know about careers in marine, engineering, and environmental sciences?
(n=64)

Chart showing percentages:
- Almost Nothing: 13%
- 2: 30%
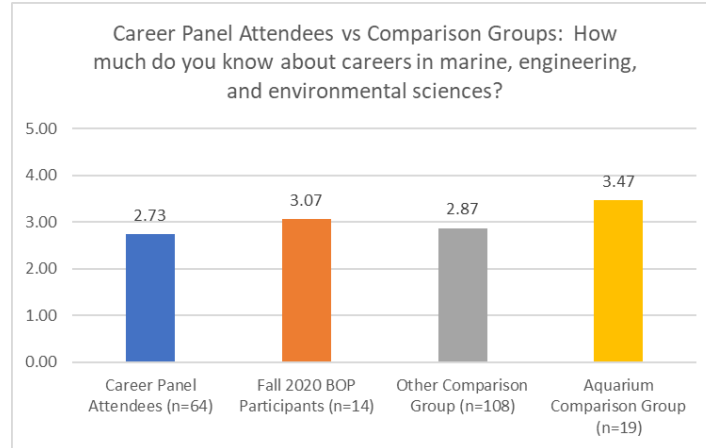- 3: 34%
- 4: 19%
- A lot: 5%

- The average response to this question was 2.74.
- Thirty-four percent response that they knew an average amount about these careers.
- Twenty-four percent responded that they knew a more than average amount.
- Forty-three percent responded that they knew less.

Career Panel Attendees and Comparison Groups

Career Panel attendees' responses were compared to three groups of students: STEM Hub participants from the Fall 2020 semester, students from Fall 2020 who completed a survey but had no experience with BOP or another science organization, and a group of students who participated in New York Aquarium programming.

Career Panel Attendees vs Comparison Groups: Perceptions of Scientific Skills

	How confident do you feel about collecting and analyzing data?	How much do you know about using computer and data science to conduct a scientific investigation?	Do you have the skills to conduct a scientific research investigation?
Career Panel Attendees (n=64)	3.50	2.75	3.14
Fall 2020 BOP Participants (n=14)	3.64	3.07	3.36
Other Comparison Group (n=108)	3.53	2.98	3.13
Aquarium Comparison Group (n=19)	3.53	2.79	3.37

- The average responses on scientific skills were similar to or lower than the students in the comparison groups. The career panels did not include activities to actively learn or utilize these skills. These results may reflect that.

Career Panel Attendees vs Comparison Groups: How much do you know about careers in marine, engineering, and environmental sciences?

- The career panel attendees' average response about their STEM career knowledge was lower than students in all the other groups.

This result is surprising, and there may be some bias in these results. Evaluators do not know how teachers or students chose to attend the career panels. Teachers may have wanted students to attend because they thought they needed to learn more about STEM careers. Additionally, in particular when compared with the general comparison group it may be a case of "you don't know what you don't know," in which students who heard about fields they previously did not know about may have been inclined to respond lower to this question that students who had not participated in any program.

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Observation Checklist

for High-Quality Professional Development Training

(Modified for BOP Training Sessions)

The *Observation Checklist for High-Quality Professional Development*[1] was designed to be completed by an observer to determine the level of quality of professional development training. It can also be used to provide ongoing feedback and coaching to individuals who provide professional development training. Furthermore, it can be used as a guidance document when designing or revising professional development. The tool represents a compilation of research-identified indicators that should be present in high quality professional development. Professional development training with a maximum of one item missed per domain on the checklist can be considered high quality.

Date:	Location:
Topic:	Presenter(s):
Number of Participants:	Observer:
GRANT NAME: ITEST STEM+C OTHER	

1. Provides a description of the training with learning objectives prior to training
   • *EXAMPLE 1: Training description and objectives e-mailed to participants in advance*
   • *EXAMPLE 2: Training description and goals provided on registration website*
   • *EXAMPLE 3: Agenda including learning targets provided with materials via online file sharing before training*	

Evidence or example:	

2. Provides readings, activities, and/or questions in accessible formats to think about prior to the training
   - *EXAMPLE 1: Articles for pre-reading e-mailed to participants in advance*
   - *EXAMPLE 2: Book for pre-reading distributed to schools before training*
   - *EXAMPLE 3: Materials made available via online file sharing*

Evidence or example:

3. Provides an agenda (i.e., schedule of topics to be presented and times) before or at the beginning of the training
   - *EXAMPLE 1: Paper copy of agenda included in training packet for participants*
   - *EXAMPLE 2: Agenda included in pre-training e-mail*

Evidence or example:

4. Establishes rapport with participants from the beginning of the session
   - *EXAMPLE 1: Trainer gives own background, using humor to create warm atmosphere*
   - *EXAMPLE 2: Trainer praises group's existing skills and expertise to create trust*
   - *EXAMPLE 3: Trainer uses topical videos to break the ice with the audience*
   - *EXAMPLE 4: Trainer refers to experiences from a previous session*

Evidence or example:

5. Connects topic to participants' context
   - *EXAMPLE 1: Trainer connects content to participants' curriculum and classrooms*
   - *EXAMPLE 2: Trainer shares participating district data profiles and asks participants to consider how the intervention might affect students*
   - *Example 3: Trainer shows examples from classrooms, then asks participants to compare the examples to what happens in their school*

Evidence or example:

6. Content builds on or relates to participants' previous professional development
    ● *EXAMPLE 1: Trainer refers to or builds on content provided in previous trainings within the sequence*
    ● *EXAMPLE 2: Trainer uses participants' knowledge of other interventions or experiences to inform training*	

Evidence or example:

7. Aligns with organizational standards or goals
    ● *EXAMPLE 2: Trainer refers to STEM+C data or computer science goals*
    ● *EXAMPLE 3: Trainer refers to program goals of student motivation toward STEM careers*
    ● *EXAMPLE 4: Trainer aligns content with grade level standards or Scope and Sequence*
    ● *EXAMPLE 1: Trainer refers to the program as part of a federally-funded grant*	

Evidence or example:

8. Emphasizes impact of content (e.g., student achievement, family engagement, client outcomes)
    ● *EXAMPLE 1: Participants brainstorm the ways the intervention will impact students and student interest in STEM careers*
    ● *EXAMPLE 2: Trainer uses data to show that the intervention is shown to positively impact post-school outcomes or positively impacts future STEM engagement.*
    ● *EXAMPLE 3: Trainer shares research that shows that the use of the instructional strategies improved academic achievement for students*	

Evidence or example:

9. Builds and reiterates shared vocabulary required to implement and sustain the practice
    EXAMPLE 1: Trainer has participants work together to formulate definitions of the intervention components and then goes overs the definitions as a group
    EXAMPLE 2: Trainer defines instructional practices according to program goals.
    EXAMPLE 3: Trainer ensures everyone has the same understanding of what's being addressed.	

Evidence or example:

10. Provides examples of the content/practice in use (e.g., case study, vignette)
    ●   *EXAMPLE 1: Trainer provides video examples of the intervention in place within classrooms at different grade levels*
    ● *EXAMPLE 2: Trainer provides hands-on demonstrations of how to use new technology tools*
    ● *EXAMPLE 3: Trainer uses a case study to demonstrate how to implement the intervention*
    ● *EXAMPLE 4: Trainers use role play or model practices for participants*	

Evidence or example:	

11. Illustrates the benefits of the material, knowledge, or practice to the participants' context.
    ● *EXAMPLE 1: Trainer describes how the intervention will benefit schools/classrooms*
    ● *EXAMPLE 2: Trainer elicits participants' ideas about how they feel their students could benefit*
    ● *EXAMPLE 3: Trainer presents a case study of a teacher who has successfully implemented the intervention*	

Evidence or example:	
███████████████████████████████████	

12.   Includes opportunities for participants to apply content and/or practice skills during training.
    ●   *EXAMPLE 1: Trainer has participants perform a mock lesson using the new instructional strategy*
    ●   *EXAMPLE 2: After receiving training on how to complete an activity, participants practice completing the activity with a sample case*
    ● *EXAMPLE 3: Participants practice identifying various instructional strategies from sample videos*	

Evidence or example:	

13. Includes opportunities for participants to express personal perspectives (e.g., experiences, thoughts on concept)
    ●   *EXAMPLE 1: Participants use their experiences and prior knowledge to fill in a worksheet on the advantages and disadvantages of various instructional approaches*
    ●   *EXAMPLE 2: Participants work together to strategize ways to overcome barriers to implementation in their school*
    ● *EXAMPLE 3: In groups, participants share personal and professional experiences related to the topic.*	

Evidence or example:	

14. Facilitates opportunities for participants to interact with each other related to training content
    ● *EXAMPLE 1: Participants independently answer questions, then discuss those answers as a large group*
    ● *EXAMPLE 2: Participants work in groups to assess implementation progress in their building*
    ● *EXAMPLE 3: Participants think/pair/share about questions within the training*	

Evidence or example:	

| 15. Adheres to agenda and time constraints
  • *EXAMPLE 1: Breaks, lunch, and dismissal occur on schedule according to written or verbal agenda*
  • *EXAMPLE 2: Trainer adjusts training content to accommodate adjustments to agenda (e.g. participants arriving late due to inclement weather)* | |

Evidence or example:	

| 16. Includes opportunities for participants to reflect on learning
  • *EXAMPLE 1: Participants strategize how to apply the knowledge from the training in their own schools*
  • *EXAMPLE 2: Participants record 3 main points, 2 lingering questions, and one action they will take*
  • *EXAMPLE 3: Green, yellow, and red solo cups at tables used to visually check for understanding at key points throughout training* | |

Evidence or example:	

| 17. Engages participants in assessment of their acquisition of knowledge and skills
  • *EXAMPLE 1: Post-test to assess trainees' grasp of learning objectives*
  • *EXAMPLE 2: After guided practice on how to complete an observation form, participants use the form to individually rate a video example and compare their responses to the trainer*
  • *EXAMPLE 3: Participants complete performance based assessment, illustrating that they have mastered the learning targets.* | |

Evidence or example:	

| 18. Offers opportunities for continued learning through technical assistance and/or resources
  • *EXAMPLE 1: Trainer describes future trainings and explains how training fits into the series*
  • *EXAMPLE 2: Trainer provides contact information for technical assistance including e-mail address and phone number*
  • *EXAMPLE 3: Trainer shows participants where to find additional materials and readings on the project website* | |

Evidence or example:	

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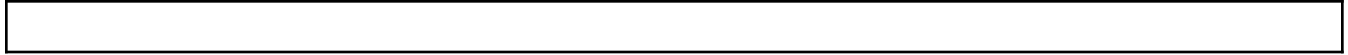
[1] Noonan, P., Gaumer Erickson, A., Brussow, J., & Langham, A. (2015). *Observation checklist for high-quality professional development in education* [Updated version]. Lawrence, KS: University of Kansas, Center for Research on Learning

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Authors' Note:

This checklist is not designed to evaluate all components of professional development, because as Guskey (2000) points out, professional development is an intentional, ongoing, and systemic process. However, training (e.g. workshops, seminars, conferences, webinars) is the most common form of professional development because it is "the most efficient and cost-effective professional development model for sharing ideas and information with large groups" (p. 23). Therefore, this checklist is designed to improve and evaluate the quality of training.

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