

**National Academy of Sciences**  
**Environmental Education 2021**  
**Final Evaluation: *Community Science in the Classroom***



**Educator Workshops**

**2019**

Three educators responded to the 2019 pilot of the workshop intake survey. One was currently teaching 9th grade, one was teaching 11th grade, and one was teaching both 11th and 12th grade. The teachers had between 3 and 15 years of experience, and all had degrees related to science and technology. Additionally, all three reported having previous background in civic engagement and advocacy related to climate change. The participants reported that they used hands-on classroom activities weekly and went outside for activities at least monthly. The three educators rated their confidence facilitating student-led inquiry on a scale of 1-5 (*Not at all* to *Very*) on the intake and exit surveys. At the start of the workshop, two educators rated their confidence 4 and one rated their confidence 5. At the close of the workshop, two rated their confidence 5 and one remained at 4. In addition to these rating questions, all three educators also described their current strategies for student-led inquiry, engaging community involvement, and involving students in civic action. These open responses were compared to those at the end of the workshop, and displayed notable differences.

On the workshop exit survey, the educators all described new strategies for facilitating student-led inquiry, which were all student-oriented and prioritized the students' voice in the discussions. The educators also described new strategies for finding community members to help students. Rather than relying on personal contacts, two teachers specifically named the Public Lab community as a new outlet for helping their students:

“Post on Public Lab! Create a class blog or video Engage with community partners (orgs, government, etc)”.

“Participate in community events, join email lists, post in Public Lab.”

Educators also related new strategies for students' civic engagement. Instead of inventing new initiatives for students or motivating them to participate in existing activities, two of the three educators described that they will encourage students to pursue civic causes that are personally important to them and create their own opportunities.

**2021**

For the 2021 workshop, five educators who taught grades 8-12 responded to the intake survey. These educators all had more than eight years of teaching experience, and all but one had a degree in science or technology. Three reported having previously worked in civic engagement

and advocacy. The participants reported that they used hands-on classroom activities weekly and went outside for activities at least once a semester. On a scale of 1-5 (*Not at all* to *Very*), three rated their confidence facilitating student-led inquiry as 4, while two rated their confidence as 5. The educators were also asked to describe their current strategies for student-led inquiry and what they wished to improve. The teachers related that they would like to improve students' ability to be active participants in their learning.

Following the workshop, six educators described their experiences on the exit survey. Four of the six teachers expressed that they now plan to provide students with the resources needed to perform their own research, and well as the opportunity to ask their own questions. Compared to the intake survey responses, the new strategies given were more student-oriented and acknowledged students' ability to gather data independently. The educators were also better able to describe the strategies they plan to use for student-led inquiry. The educators expressed having acquired strategies for engaging community members to help students. Two teachers specifically named the Public Lab community as their intended source of outside help. Furthermore, all the educators listed strategies for getting students involved in civic engagement. Four of the educators reported that they would start their students off with research and/or collecting data. Three mentioned encouraging students to contact local elected/regulatory officials.

When asked again to rate their confidence facilitating student-led inquiry on a scale of 1-5, all the educators endorsed 5 for *very confident*. The participants were also asked to rate their confidence with other aspects related to the workshop. The average exit ratings compared to those of the intake survey are shown in the table below. All six participants endorsed that they felt ready to implement the lessons of the workshop into their classrooms.

**Table 1. Comparison of Average Confidence Rating by Workshop Aspect\***

<b>Workshop Aspect</b>	<b>Mean Confidence Before Workshop</b>	<b>Mean Confidence After Workshop</b>
Facilitating student-led inquiry	4.40	5.00
Facilitating helpful people from outside the classroom	3.75	4.67
Facilitating students to take civic action	4.00	4.50

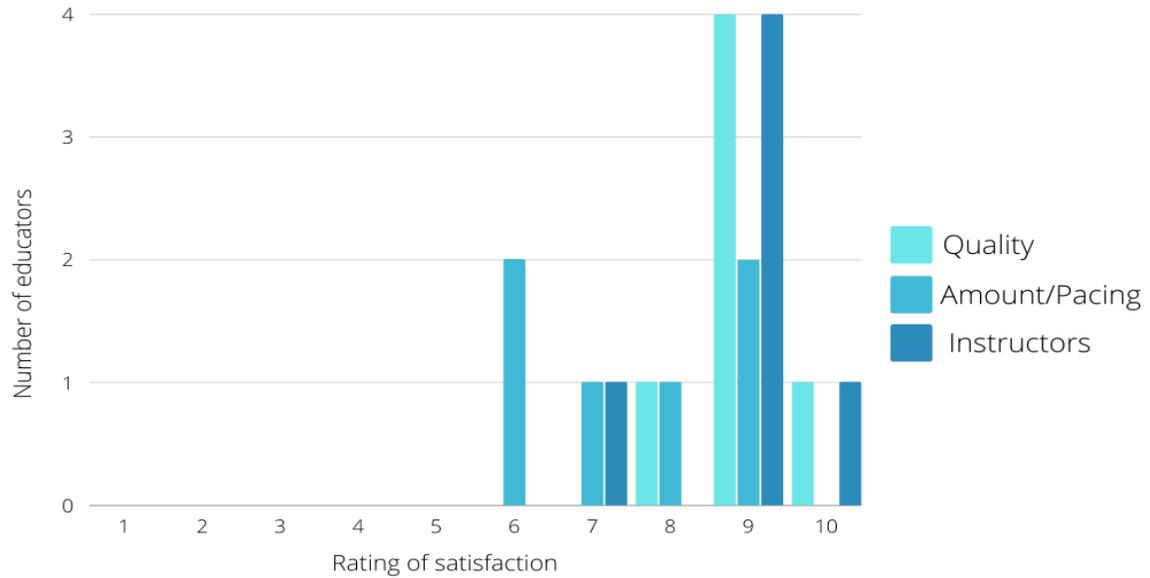
\*Note: Sample size too low to determine statistical significance.

In regard to the usefulness of Public Lab's help, all participants rated their likelihood of recommending Public Lab resources to colleagues as 9 or 10 on a scale of 1-10. The educators also rated the workshop as satisfactory or highly satisfactory on several factors, which is displayed in Figure 1.

**Figure 1.**

**Distribution of Educators' Satisfaction with Aspects of Workshop**

(n=6)



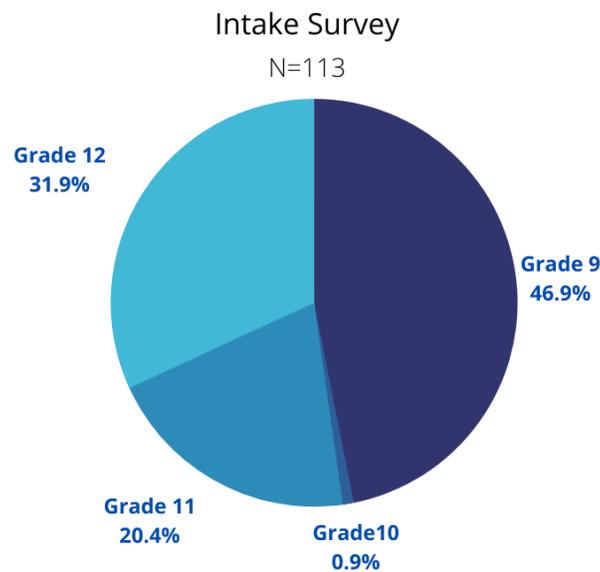
**Student Lessons**

**2019**

In 2019, the intake survey collected responses from 113 participating students, of which 46.9% were 9th graders, 0.88% were tenth graders, 20.4% were eleventh graders, and 31.9% were twelfth graders. Due to the COVID-19 pandemic, the exit survey was not administered for this round. Therefore, comparison responses were not collected to measure change in the knowledge, attitudes, or skills over the course of the program term. However, the responses to this survey act to help contextualize students' understanding of the environmental issues in their locality.

**Figure 2.**

### 2019 Distribution of Grade Levels

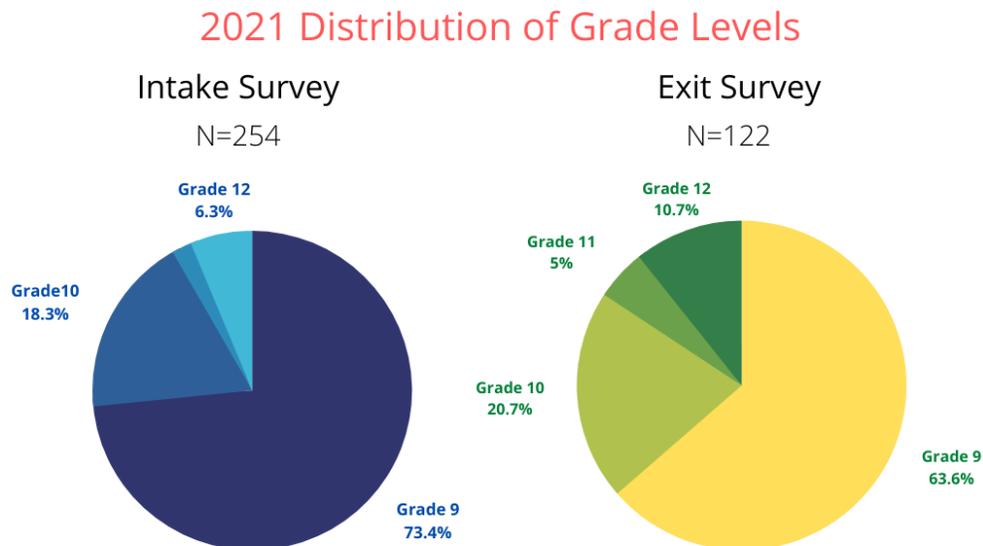


On the 2019 student intake survey, 50.8% reported that they had noticed the environment having health effects on those within their community. Thus, half of this group of students had observed some issue. Twenty-four percent of 2019 students had parents and 26.7% had family/community members who worked in the sciences. Thus, they could have been made aware of issues by these adults before the program. Additionally, 62.7% of the 2019 cohort reported that their school was very supportive of students desiring to take action to create positive change.

### **2021**

In the intake survey for 2021, responses were collected from 254 students. Ninth graders represented 73.4% of the sample, tenth graders represented 18.3%, eleventh graders represented 2.0%, and twelfth graders represented 6.4%. Therefore, ninth grade was vastly over represented in this sample.

**Figure 3.**

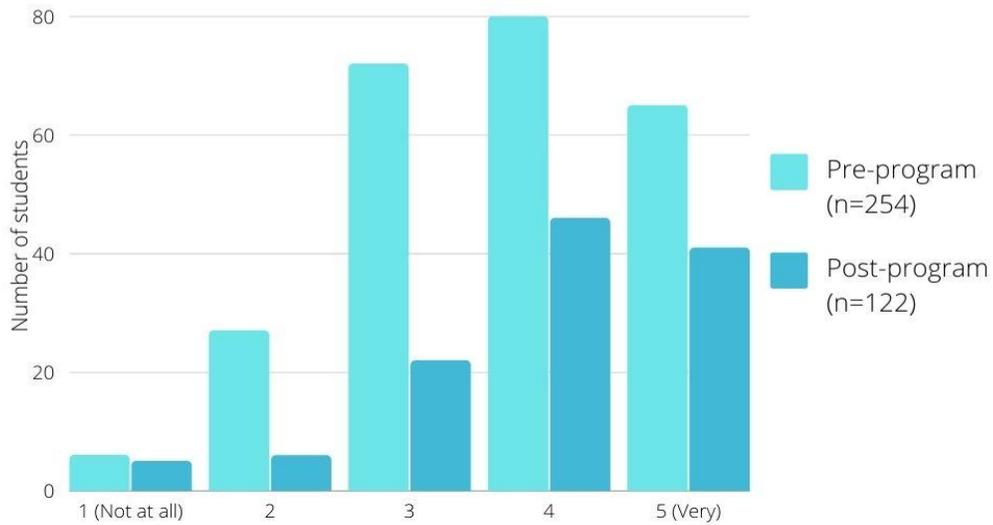


Of these students, 24.8% reported noticing health effects in their community. Twenty-six percent had parents and 22.5% had family/community members who worked in the sciences. To further contextualize students' environmental science learning at the start of the program, 61.8% of the 2021 cohort reported that their school was very supportive of students desiring to take action to create positive change.

A primary aim of this program was to improve participating students' scientific understanding of local environmental issues. Additionally, the program intended to boost students' confidence with conducting science-based projects. Therefore, to evaluate the initial outcomes of the program, students' 2021 intake and exit survey were compared to determine if the students noticed changes in their attitudes, knowledge, and confidence related to science. For the exit survey, 122 responses were collected. Following an independent sample *t* test, we found that participants did report statistically significant changes in some areas following the program. After participating in the project, students on average felt that learning science was more meaningful to the real world ( $t(368) = -2.14, p = 0.03$ ) and a more collaborative experience ( $t(370) = -3.10, p = 0.002$ ). The mean score for these measures increased 0.25 and 0.33, respectively.

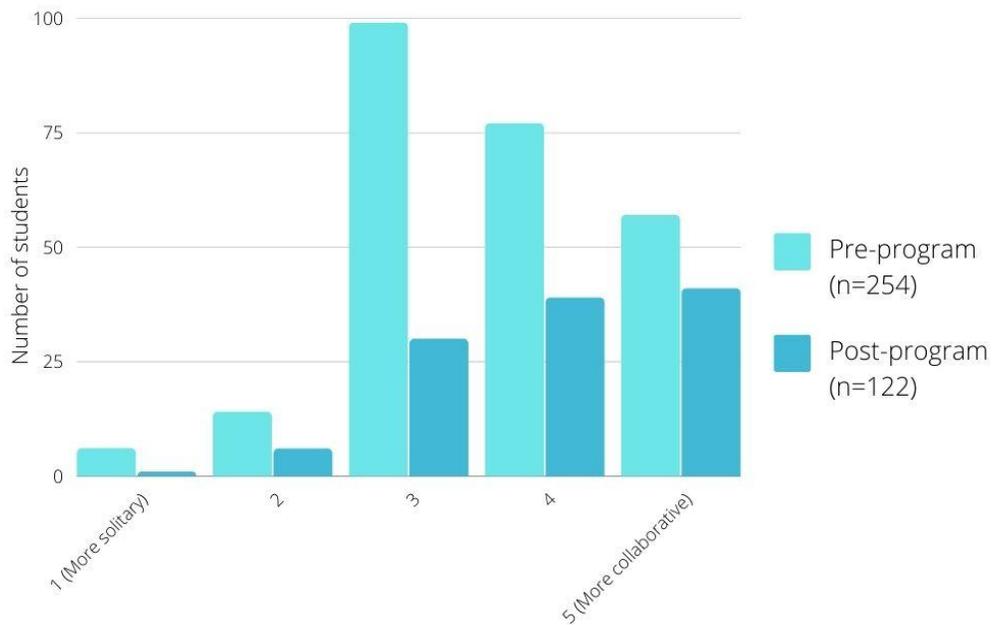
**Figure 4.**

**2021 Comparison of Students' Ratings:**  
"[D]o you feel that what you've done is science class is meaningful in the real world?"



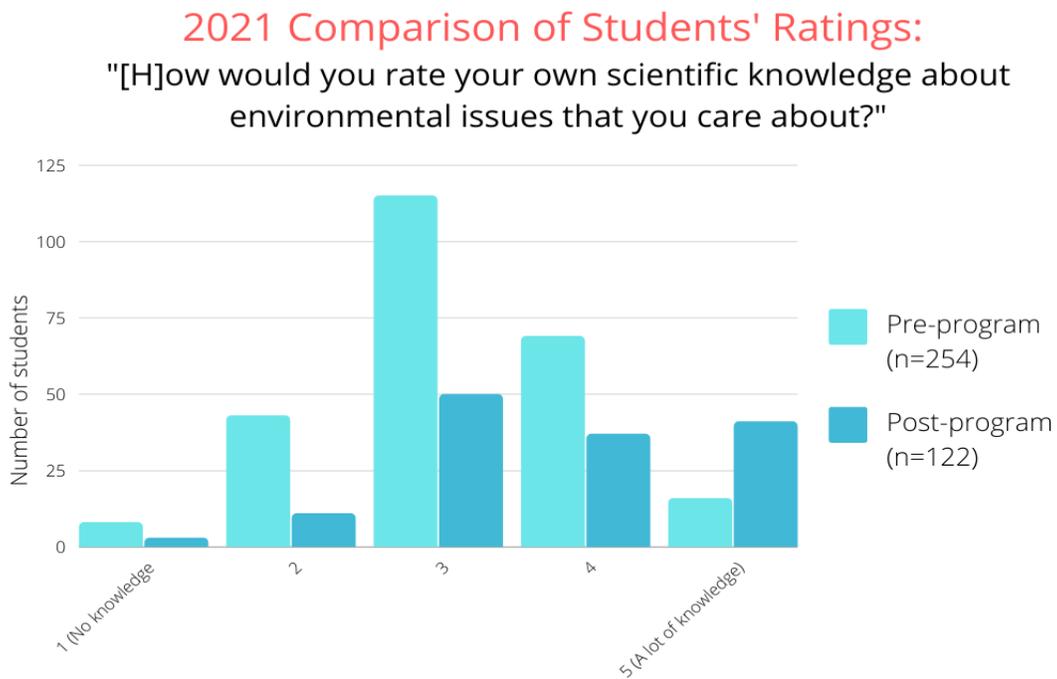
**Figure 5.**

**2021 Comparison of Students' Ratings:**  
"[D]o you view science as being more solitary or more collaborative?"



The students also rated their scientific knowledge significantly higher following the program, with a mean post-test rating of 3.17 compared to 3.48 for the pre-test ( $t(369) = -3.11, p = 0.002$ ). Furthermore, significantly more students on average expressed interest in going to college when compared to the intake survey ( $t(374) = -2.10, p = 0.04$ ). Students' average self-ratings did not display a statistically significant change in their enjoyment of science nor their confidence with science, ability to make change, or ability to affect the local environment. The differences in the other self-rated survey items are displayed in Table 2 below.

**Figure 6.**



**Table 2. 2021 Students' Self-Assessment Mean Scores**

Student Self-Assessment Item	Intake Survey Mean	Exit Survey Mean
School Importance	4.28	<b>4.42</b>
Enjoyment of Science	3.55	3.57
<b>Meaningfulness of Science*</b>	<b>3.68</b>	<b>3.92</b>
Confidence about Science	3.52	3.64
<b>Collaborativeness of Science*</b>	<b>3.65</b>	<b>3.97</b>

Confidence about Ability to Improve Issues	3.77	3.75
Confidence in Ability to Make Change	3.52	3.57
<b>Knowledge of Science*</b>	<b>3.17</b>	<b>3.48</b>
Ability to Affect Change in Local Environment	3.54	3.68

\*Statistically significant difference in mean ( $p \leq 0.05$ )

### Pulse Surveys

Throughout the 2021 round of the program, students were given short, single-item assessments following each program lesson so as to monitor implementation. On each pulse survey, the students rated their satisfaction with the lesson on a scale of 1-5. Responses were collected for 13 separate lessons to classes of various sizes. Generally, the participants rated the lessons as satisfactory, with average ratings ranging from 3.56 to 4.29. The results of the pulse surveys are illustrated in the table below.

**Table 3. 2021 Frequency and Average of Students' Pulse Survey Ratings**

Pulse Survey	Frequency of Rating					Average Rating
	1	2	3	4	5	
1.1	7	14	63	84	39	3.64
1.2	2	4	39	72	46	3.94
1.3	7	10	56	99	62	3.84
1.4	4	3	45	67	42	3.85
2.1	4	5	38	45	51	3.92
2.2	0	0	5	4	7	4.01
2.3	0	1	6	9	13	4.11
2.4	1	1	11	12	16	3.96
3.1	4	1	14	40	65	4.29
4.1	1	1	12	14	14	3.93
4.2	2	3	16	40	54	4.23
4.3	0	1	4	7	0	3.56

Note: Heat map reflects the comparative frequency of responses by lesson.

## **Focus groups/Interviews**

In the 2021 intake interviews and focus groups, 22 students participated either individually or as part of a group. Nearly all these students drew connections between human health and the health of the environment, as well as between human actions and the health of the environment. Most of the students also expressed a love of science, an enjoyment of collaborative work, and a belief that they were potential changemakers. A large majority of the participants expressed that they were highly confident in their ability to act as a changemaker. One student summarized his confidence as follows:

“I'd say everyone has the potential to be a change maker or have an impact on society, it's just up to them to take that step forward.”

All interview participants reported that they enjoyed the projects they were starting in the program. Some students were already able to describe how the program was helping them to rethink how common community issues were affecting the environment:

“I learned that there is a correlation between potholes, and the weather and potholes and pollution. As in if you have less potholes, it will lead to a decrease in pollution as the vehicles who had to stumble over the potholes [will be] lower, which in turn leads to less, less gas and pollution in the air.”

Participants were interviewed again at the close of the program. All of the students expressed that they enjoyed the now completed project. Several students mentioned liking the data collection and collaborative work aspects. Many reported that the program raised their awareness of local environmental issues and taught them a great deal about scientific methods. Generally, the students would recommend the program to other students, and believe it could raise the awareness of other students as well. Negative feedback was provided by four students, who concluded that the project could have used clearer directions at the start and a pace that better suited a busy student schedule. Overall, the participants expressed consistently that they learned a great deal about conducting environmental science research and current environmental challenges through their work with the project, as described in the responses below:

“I learned from my experience with this project. I learned that sometimes experiments don't go the way it's [planned]. As I was kayaking with one of my friends, we were collecting data and the thing that we were using to collect the data for microplastics, it's a broom. So, yeah, it completely fell apart, we had a paddle around to get it out of the water. So, for us, we didn't collect that much data because of it... I learned, like, it's okay experiments fail... [T]he tools that you're using aren't always going to work. But it was a learning experience.

“It was a lot of fun to plan out an experiment and actually see it through. I think it was worth it. And I think that it can have an effect on people's lives after that because you actually, like, understand how, like, doing an experiment goes out, and it's one thing to

do. So yeah, I would suggest to anyone who is going to take biology another year to participate fully in the project.”

“I gained awareness of mercury in our soil. Mercury in our soil, and in our air and it’s getting, like, it’s in our air and so we, like, we breathe it in, and it’s getting other people sick.”

## **Discussion**

The findings from this evaluation generated several important summations regarding the program. Concerning educators, we can conclude that the teachers who participated in the pilot workshops gained new understanding of how to facilitate student-led inquiry in their classrooms, given that the 2019 and 2021 teachers were able to describe additional student-centered strategies they planned to use after the workshop. The teachers indicated they were more confident in their teaching practices, as all the teachers rated their confidence highly following the end of the program. The educators also expressed knowledge of how to better involve students in research and civic engagement to address environmental concerns. Regarding implementation, the workshops were described as high quality experiences for the participants, and educators were very satisfied with the instructors and content. Therefore, the educator workshops appear to be meeting expectations for dispersing student-led inquiry skills, and the educators are uptaking the resources and are receptive to the experience. We recommend expanding the workshops to serve larger groups of educators as resources and global context allow.

Concerning students, we conclude that, despite a reduction in comparative data due to the 2020 pandemic, the 2021 students displayed notable positive changes following their participation. After the program, the students came to view science as more meaningful to their lives, and as a more collaborative pursuit rather than a solidarity study. Furthermore, the student participants felt they increased their scientific knowledge while working with the project. The observation is bolstered by student feedback from the interviews and focus groups. There is consensus among the students that they know more about how to conduct environmental science following their work with the project. In addition, this evaluation found that many students start the program aware of some of the environmental issues that surround them, and learn more through the project. The students also generally express feelings of empowerment at the start of the program, as they already viewed themselves as somewhat confident changemakers. Regarding implementation, the lessons garnered overall positive reactions from the students, with most of the lessons rating satisfactory or very satisfactory on the pulse surveys. Student reactions to the project were emphatically positive, with most students relating that it was a fun, informative experience. Given the measurable changes to students’ attitudes and perceived knowledge, as well as the positive feedback, the program is meeting many stated expectations. Further implementation with larger groups of more evenly distributed grade levels is recommended to explore the effects of the program long-term.