GLOBE Student Research Symposia 2019 Evaluation Report

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Contents

Executive Summary

The 2019 Global Learning and Observations to Benefit the Environment (GLOBE) Student Research Symposia (SRS) were supported by the National Aeronautics and Space Administration (NASA Grant No. 80NSSC18K0135) and Youth Learning as Citizen Environmental Scientists (YLACES). The symposia give students and teachers an opportunity to share the results of their GLOBE scientific research projects, get feedback from knowledgeable reviewers, engage in peer review, and participate in experiential learning activities. The 2019 symposia were held in the spring in six regions across the U.S. A total of 261 students, 66 teachers, 32 GLOBE Partnership representatives, 14 scientists and reviewers, and 93 other registrants attended. A total of $90K in GLOBE travel, meals, and lodging funds supported SRS attendance for 266 teachers and students from high-need schools, expanding access to those for whom it would have otherwise been out of reach. This summary highlights findings of the 2019 GLOBE SRS evaluation. Data sources include participant registrations, student survey data collected at the beginning (pre-test) and end (post-test) of each SRS, and teacher survey data collected at the end of each SRS.

Who participated in the 2019 GLOBE SRS?

261 students

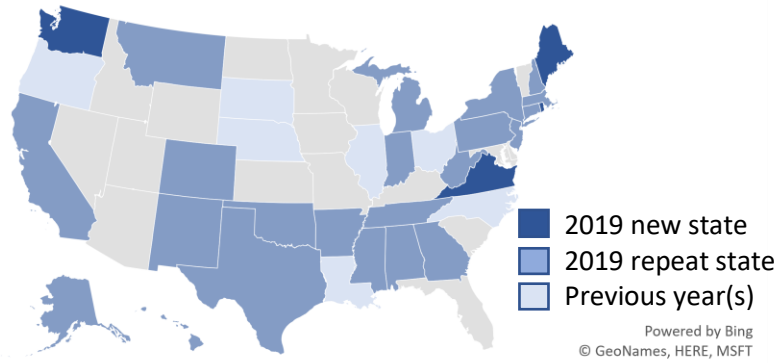
66 teachers

49 schools

26 states

The number of states represented at the GLOBE SRS has increased from 20 in 2016 to 26 in 2019, with different states represented year to year. In that same timeframe, the number of registered students increased by 57% from 166 to 261, and the number of teachers by 53% from 43 to 66.

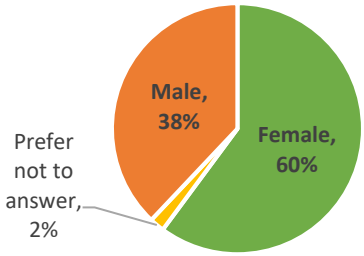
26 States Represented at the **2019** GLOBE SRS
34 States Total since 2016

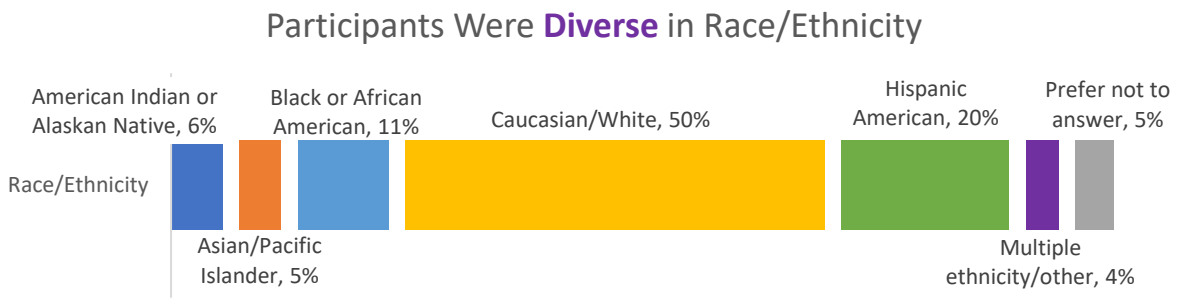


At the 2019 SRS:

- The largest percentage of students (45%) were in grades 10 to 12, particularly in tenth and eleventh grades; 26% percent were in grades 7 to 9 and 28% in grades 4 to 6.
- **The majority of students were reported by parents and guardians to be female at 60%; males represented 38%.**
- **Students were diverse in race and ethnicity.** Those reported by their parents and guardians as Caucasian/White comprised 50%, Hispanic American 20%, Black or African American 11%, American Indian or Alaska Native 6%, and Asian/Pacific Islander 5%.

More Participants Were **Girls** in 2019





- **Twenty-three percent of students lived in households where languages other than only English were spoken.** Household first and second languages included Spanish, Arabic, Chinese, Hindi, Punjabi, Apache, and American Sign Language, among others.
- Of students' parents and guardians reporting household income, most (73%) reported between $25,000 - $149,999; **15% of responding parents and guardians reported the lowest household income category of $0 - $25,000, below the 2019 federal poverty guideline for a family of four.**
- Teachers most frequently described their school communities as urban (45%), followed by rural (34%) and suburban (17%). **Two-thirds of teachers (66%) reported at least half the learners at their schools qualify for the federal free and reduced-price lunch program.** About a quarter (26%) reported English is not the first language of at least half the learners.

Impact of the GLOBE SRS on Students

Students reported a significant gain in their confidence, skills, and interest in science as a result of participation in the GLOBE SRS.

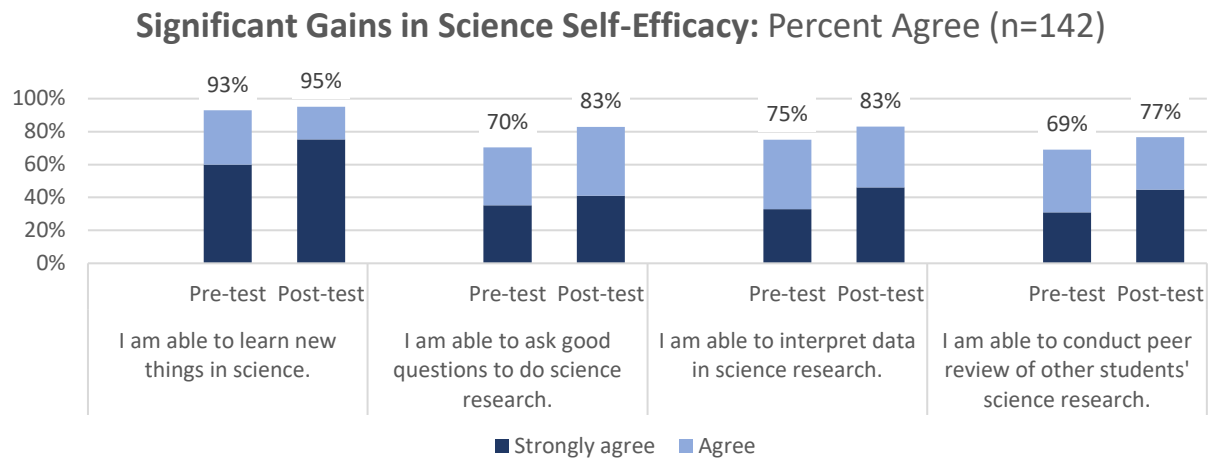
- Of 116 students[1] who responded to the open-ended post-test question, "did participating in the symposium impact your understanding of the scientific process and what it's like to do science research?" 79% responded affirmatively.

"…I began to realize the importance of science and research in our lives. The research symposium left a big impact on my life." – 10th grade student, Midwest

"Participating in this year's SRS has given me more inspiration and ideas on the scientific process. Doing science research for my project was fun and interesting." – 10th grade student, Southwest

- Students indicated their level of agreement with statements about science self-efficacy before and after the SRS. The summed agreement score improved significantly, and nine individual items improved significantly, from pre-test to post-test. The item showing the most significant improvement was "I am able to learn new things in science," followed by "I am able to ask good questions to do science research," and "I am able to interpret data in science research."
- Two of the relatively lower-scoring items at pre-test showed significant improvement between pre-test and post-test: "I am able to conduct peer review of other students' science research" and "I am able to construct scientific arguments."

[1]A sample of 142 matched pre- and post-test student surveys (54%) were analyzed for the rest of this summary.

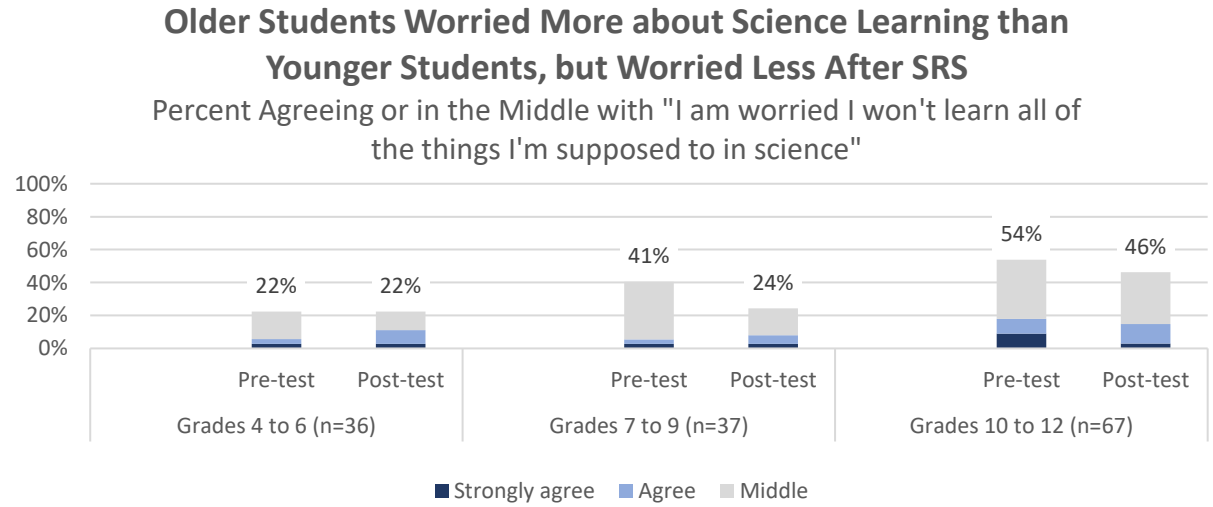


Impact by Demographics

Gender. A gender gap closed on "I am worried I won't learn all of the things I'm supposed to in science." Female participants were more worried at pre-test, agreeing or in the middle with the statement more (46%) than male participants (30%). The percentage agreeing or in the middle decreased significantly by post-test for female participants (34%) while staying level for male participants (30%).

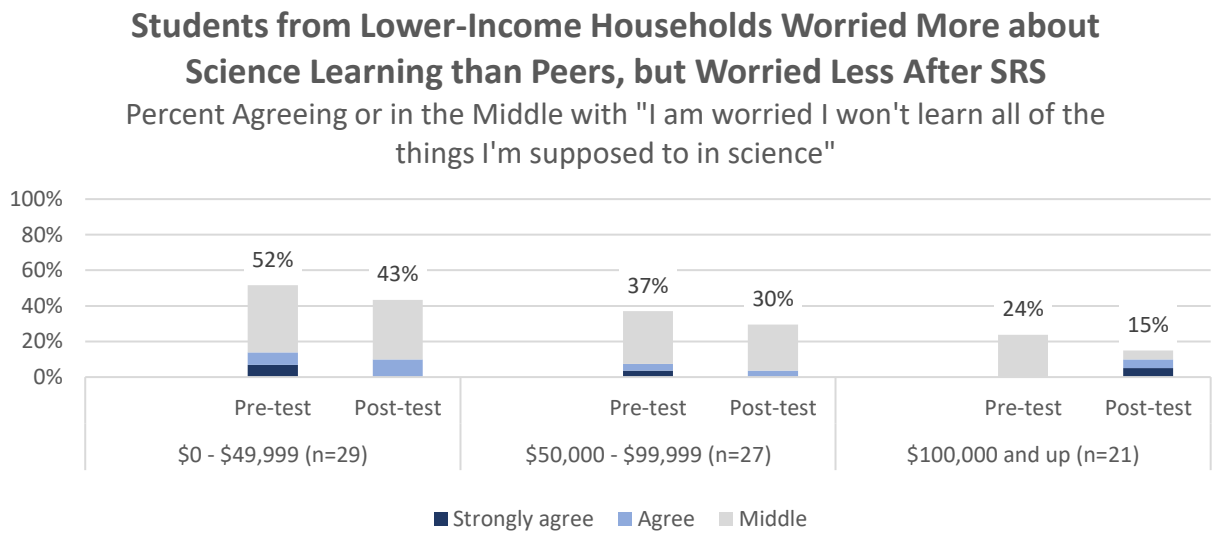
Race and Ethnicity. At pre-test, Black or African American students agreed less (59%) than white students (82%) with the statement "I am able to interpret data in science research." By post-test, the difference narrowed somewhat with the percent agreement increasing for both groups (70%, 88%).[2]

Grade. Students in grades 10 to 12 agreed or were in the middle (54%) significantly more than students in grades 4 to 6 (22%) with "I am worried I won't learn all of the things I'm supposed to in science" at pre-test. There was still a difference between groups at post-test, but it was not statistically significant.



[2] This finding was inconclusive likely due to small and imbalanced group sizes in the sample but was retained in reporting because it neared statistical significance and the difference is descriptively notable.

Income. There was a significant gap of over seven points on the summed score of agreement with all science attitude and self-efficacy statements between students from low-income (85.19) and high-income (92.63) households at pre-test. There were also significant differences by household income on "I am worried I won't learn all of the things I'm supposed to in science" as well as with "I get embarrassed in science." Students in the low-income group agreed or were in the middle with both statements (52%, 23%) more than the high-income group participants (24%, 0%). Although there were still differences in these percentages at post-test, they were no longer statistically significant.



Impact of the GLOBE SRS on Teachers

Asked if participation improved their ability to integrate science research into their classroom or program, 32 of 36 teachers responding (84%) said "yes."

Teachers' comments in response to an open-ended follow-up question (28) frequently focused on new approaches or ideas for teaching (15).

"It has made me feel more confident in asking the questions and giving the students more time to discuss and/or explain themselves. Stop rushing them and let them be more creative." – Teacher, Midwest

"Seeing the final product then having this in mind while teaching really helps me push the students to produce better quality research." – Teacher, Pacific

"I really learned how to better facilitate scientific writing. I am looking forward to expanding next year. I loved this project!" – Teacher, Southwest

"Talking to other teachers and students about their projects help me find new things/activities to do in class with my students." – Teacher, Northeast & Mid-Atlantic

Satisfaction with the GLOBE SRS

Students and teachers were asked about their satisfaction with the 2019 GLOBE SRS. Overall, they reported positively on their experiences.

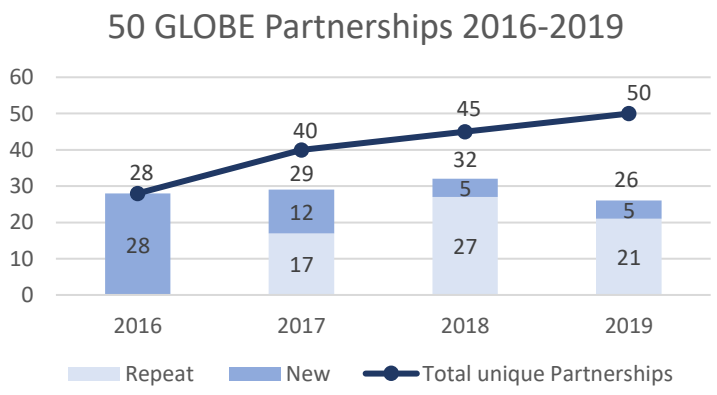
- The student post-test survey asked which SRS events they enjoyed the most, and which they enjoyed the least. They were invited to select multiple events. Students made many more selections of events they enjoyed the most (601) compared to events enjoyed the least (165).
- **The SRS events selected by students as those they enjoyed most involved interaction with scientists.** Meeting scientists was selected most frequently (84), followed by review from scientists (82), and research presentations to the reviewers (77).
- **The SRS events selected by students as the events they enjoyed the least involved sitting and listening to speakers rather than active participation.** Although again, few selections were made, keynote speaker was selected most frequently (21) followed by the opening remarks (20).
- **Ninety-two percent of teachers were satisfied (40%) or very satisfied (53%)[3] with the SRS for themselves, and 92% were satisfied (30%) or very satisfied (62%) for their students.**
- About 90% of teachers or more were satisfied or very satisfied with most SRS events. Topping the list at 97% satisfied (35%) or very satisfied (62%) was review from scientists. At the lower end of the scale but still with high ratings of satisfaction were the keynote speaker (86%), the opening remarks (85%), peer review from other students (82%), and evening activities (79%).

This is a great real world experience for the students. They see a very high level of peer research and have an opportunity to present for STEM professionals. -Teacher, Southwest

"I enjoyed hearing someone's experience, and I felt professional and important with the scientists." – 7th grade student, Northeast & Mid-Atlantic

GLOBE Partnerships

The GLOBE program has added new regional Partnerships across the country each year. Participation of Partners—in terms of attending the SRS and/or mentoring students on their science projects—varied year to year, and the number dipped somewhat in 2019, but the cumulative number of GLOBE Partnerships has increased steadily from 28 in 2016 to 50 in 2019.



GLOBE Data & Projects

- Between August 2018 and July 2019, 44 schools uploaded data to the GLOBE website – three times as many as the prior year. Additionally, 33 submitted projects to the GLOBE website.

[3] Total exceeds 92% due to rounding.

Introduction: About the GLOBE SRS

The 2019 Global Learning and Observations to Benefit the Environment (GLOBE) Student Research Symposia (SRS) were supported by the National Aeronautics and Space Administration (NASA, Grant No. 80NSSC18K0135) and Youth Learning as Citizen Environmental Scientists (YLACES). GLOBE offers an array of resources to support youth engagement in scientific research in the U.S. and worldwide, including learning activities, research protocols, data sharing, mentorship, teacher professional development, and expert consultation. Between August 2018 and July 2019, 44 schools uploaded data to the GLOBE website – three times as many as the prior year— and 33 submitted GLOBE research projects. The annual full weekend symposia give students and teachers an opportunity to share the results of their projects in an immersive science learning environment, get feedback from knowledgeable reviewers and peers, and participate in experiential learning activities. The 2019 SRS were held in the spring in six U.S. regions. In total, 261 students and 66 teachers from 49 schools, 32 representatives from 21 GLOBE Partnership organizations, 14 scientists and reviewers, and 93 other registrants attended, and 114 GLOBE research projects were presented (Table 1). A total of $90K in GLOBE travel, meals, and lodging funds supported SRS attendance for 266 teachers and students from high-need schools, expanding access to those for whom it would have otherwise been out of reach.

Table 1. Students, teachers, GLOBE Partnership organizations, and projects at the 2019 GLOBE SRS by region.

Region & Dates	Location	Students	Teachers	Partnerships	Projects
Midwest April 5-6	University of Northern Iowa, Cedar Falls, IA	36	5	2	20
Northeast/Mid-Atlantic May 31-June 1	Boston University, Boston, MA	79	20	5	38
Northwest May 2-4	Seattle, WA	10	5	4	3
Pacific April 26-27	NatureBridge of Golden Gate, Sausalito, CA	71	13	2	26
Southeast May 10-11	Atlanta, GA	26	9	4	11
Southwest May 17-19	Mescalero, NM	39	14	4	16
	TOTAL	**261**	**66**	**21**	**114**

Figure 1. Photo from the 2019 Northeast & Mid-Atlantic GLOBE SRS.

The agenda for each 2019 regional symposium varied somewhat, taking advantage of host city attractions and local expertise. Core events for all symposia included opening remarks, keynote speakers, student poster presentations with scientist and peer reviews, teacher professional development, evening activities, and closing ceremonies. (Students examine a tree in Boston, Figure 1.)

The number of states represented at the GLOBE SRS has increased from 20 in 2016 to 26 in 2019, with different states represented year to year. In that same timeframe, the number of registered students increased by 57% from 166 to 261, and the number of teachers by 53% from 43 to 66. (Figure 2.)

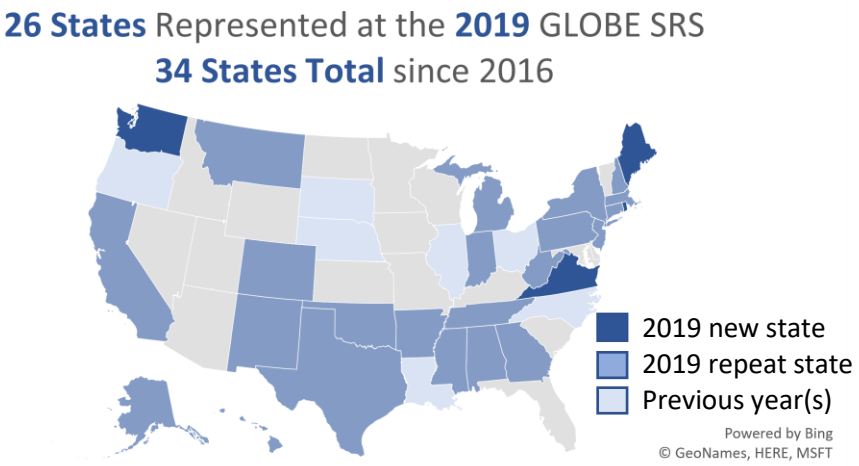


Figure 2. States participating in the SRS in 2019 and previous years.

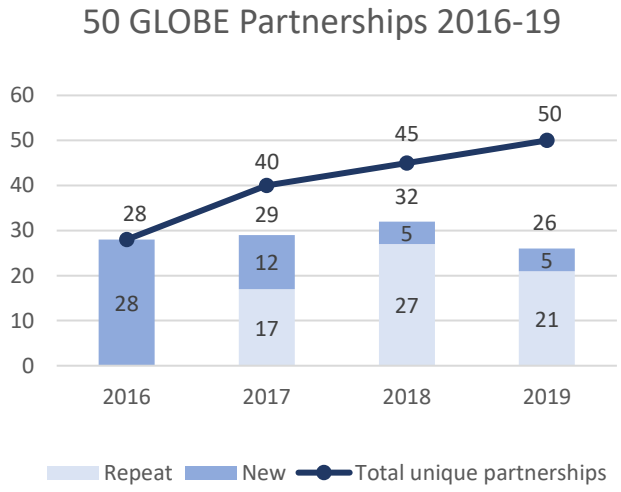


Figure 3. GLOBE Partnerships over time.

GLOBE has added new Partnerships across the country each year, including institutions of higher education, school districts, State Department(s) of Education, or informal education organizations (501c3) such as STEM learning centers, museums, and foundations. They enter into agreements to provide mentorship and other educational supports. Participation of Partners—in terms of attending the SRS and/or mentoring students on their science projects— varies year to year, but the cumulative number of GLOBE Partnerships has increased steadily from 2016 to 2019. (Figure 3.)

About This Report

The focus of this report is evaluation findings from the 2019 SRS. These findings are intended to help GLOBE program leaders and funders better understand who participates in the SRS and the impact of the SRS on participating students and teachers. Data sources for the evaluation include participant registrations, student survey data collected at the beginning (pre-test) and end (post-test) of each SRS, and teacher survey data collected at the end of each SRS. Please see Appendix A for more information about survey instruments, samples, and analysis.

Demographics

This section describes the school context and demographics of 261 student participants (100%) and 65 teacher participants (98%) pre-registered for the SRS. In addition to serving a descriptive purpose, the results will help program leaders to assess the effectiveness of efforts to make the SRS inclusive of

students from underrepresented groups and communities who may not typically have access to STEM experiential learning opportunities. School characteristics were reported by teachers during registration for the SRS. Student demographics were reported via a parent and guardian student registration survey.

Student Demographics

Grade and School Characteristics

Twenty-eight percent of students were in grades 4 to 6, 26% in grades 7 to 9, and 45% in grades 10 to 12.[4] The largest percentages of students were in grades 10 and 11 specifically, with each representing 19% of all participants. According to their teachers, students' school communities were close to evenly rural (29%) and urban (30%), with somewhat fewer characterized as suburban (23%). Approximately 19% of registered students were reported by their teachers to attend schools where English is not the first language for at least half the learners, and approximately 60% of students were reported to attend schools where at least half of the learners qualify for the federal free and reduced-price lunch program.[5]

Gender

The majority of students registered for the 2019 GLOBE SRS were reported by their parents or guardians to be female at 60%, and 38% were reported to be male. Two percent of respondents preferred not to answer. (Figure 4.)

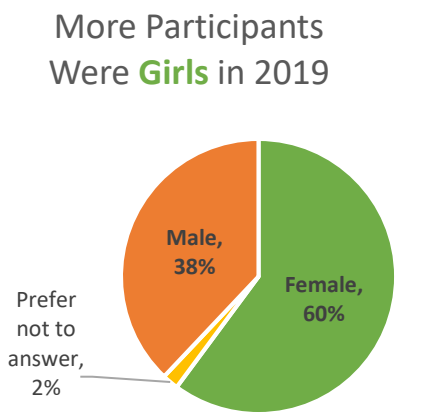


Figure 4. Student gender at the 2019 SRS.

Race/Ethnicity

The students at the 2019 GLOBE SRS were diverse in race/ethnicity. Those reported by their parents and guardians as Caucasian/White comprised 50%, Hispanic American 20%, Black or African American 11%, American Indian or Alaska Native 6%, and Asian/Pacific Islander 5%. Four percent were reported as multiple ethnicity/other, and 5% of respondents preferred not to answer. (Figure 5.)

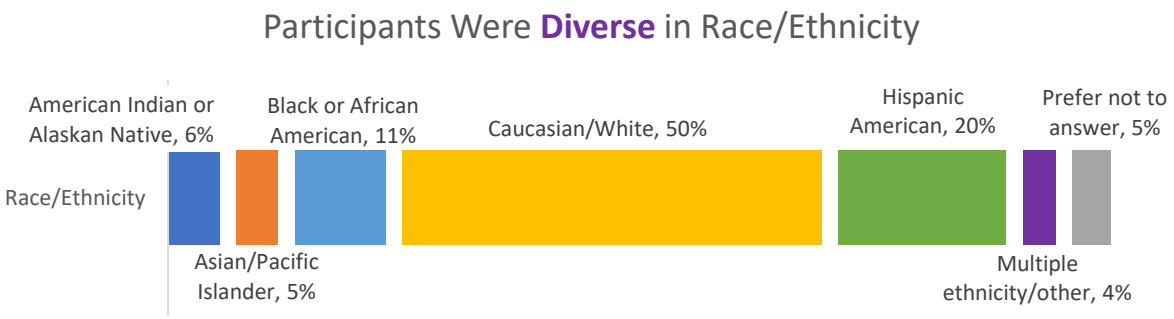


Figure 5. Student race/ethnicity at the 2019 SRS.

[4] Total is less than 100% due to rounding.

[5] Teacher-reported school characteristics data were merged with student data by school for the analysis reported on here. These data were missing for approximately 20% of student cases.

Home Language

As reported by their parents and guardians, 23% of students lived in households where languages other than only English were spoken. English and another language were spoken in 16% of students' households. Most frequently that other language was Spanish with bilingual English and Spanish households comprising 7%, and Spanish was the primary language spoken in additional 6% of students' households. Other languages spoken in students' households included Arabic, Chinese, Hindi, Punjabi, Apache, and American Sign Language, among others.

Household Income

Thirty-four percent of respondents in the parent and guardian student registration survey preferred not to answer a question about household income. Those who did answer reported a wide range of household incomes with most (73%) between $25,000 - $149,999. Twelve percent of those responding reported a household income of $150,000 and up, and 15% reported the lowest income category of $0 - $25,000. (Figure 6.) The federal poverty guideline for 2019 was $25,750 for a family of four.[6]

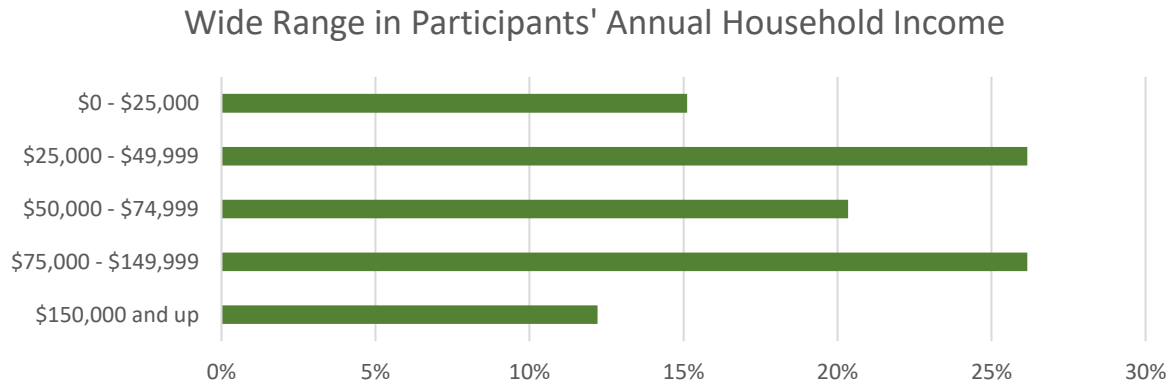


Figure 6. Annual household income of students attending the 2019 SRS as reported by parents/guardians.

Teacher Demographics

Nearly three-quarters of the teachers (72%) most closely identified their gender as female and one quarter (25%) as male. The large majority identified their race/ethnicity as Caucasian/White (82%), followed distantly by Hispanic American (9%). The remaining 9% identified their race/ethnicity as American Indian or Alaska Native, Asian/Pacific Islander, or Black or African American.

Teachers most frequently described their school communities as urban (45%), followed by rural (34%) and suburban (17%).[7] Two-thirds (66%) reported that at least half of the learners at their schools qualify for the federal free and reduced-price lunch program. Approximately a quarter (26%) reported that English is not the first language of at least half of the learners at their schools. In some cases, multiple teachers from the same school registered for the SRS. Therefore, this is not an accounting of the characteristics of all the *schools* participating in the SRS, as those schools with multiple teachers attending are overrepresented in the teacher registration data; rather, they reflect the school environments experienced by the 65 *teachers* in the registration dataset.

[6] U.S. Department of Health and Human Services: https://aspe.hhs.gov/2019-poverty-guidelines.
[7] Approximately 5% did not provide a response.

A little under a third of registered teachers (29%) had been teaching for five years or less, including 9% novice teachers that had been teaching for up to one year. Forty-three percent had been teaching between six and 15 years, and 25% for more than 15 years. Almost half (45%) had attended an SRS in previous years, including 19% that had attended just the year before, and 25% that had attended multiple times before. The 2019 SRS was the first for 54% of registered teachers.

Student Survey Results

In this section, we report on the results of the pre-test (at the beginning of the SRS) and post-test (at the end of the SRS) student surveys. Students who did not provide active assent for participation in *research*, or who were opted out of *research* by their parents or guardians, were excluded from analysis of the student survey data for evaluation purposes as well. These and other exclusions resulted in a matched pre-post sample of 142 students. Please see Appendix A for more information about case exclusions, sample demographics, and statistical test results.

Student Survey Questionnaire

The student self-report survey questionnaire included 17 statements with repeated measure at pre-test and post-test to assess changes in science attitudes and self-efficacy resulting from participation in the SRS. (Appendices B and C.) Students rated each item from 1 'strongly disagree' to 6 'strongly agree.' A summed score was computed for the 17 items, with items #14-17 reverse coded (as lower scores are positive and higher scores are negative for these items as written). (Table 2.)

Table 2. Student survey item averages at pre-test and post-test.

Student Survey Items		
1 'Strongly disagree' to 6 'Strongly agree'	**Pre-test**	**Post-test**
1. I am able to learn new things in science.* **	**5.51**	**5.69**
2. I am able to earn a good grade in my science classes.	5.48	5.53
3. I am able to ask good questions to do science research. **	**5.01**	**5.18**
4. I am able to analyze data to do science research.	5.24	5.34
5. I am able to interpret data in science research. **	**5.02**	**5.22**
6. I am able to construct scientific arguments.*	4.82	4.96
7. I am able to conduct peer review of other students' science research. **	**4.89**	**5.12**
8. I am good at science.*	5.16	5.29
9. I am good at learning new things in science.	5.31	5.38
10. Being good at science is important.	5.35	5.38
11. I enjoy science.	5.42	5.43
12. I want to have a career in science someday.	4.62	4.70
13. I am proud of my accomplishments in science.*	5.35	5.52
14. I get bored in science.	2.12	1.92
15. I get angry when I don't understand something in science.*	2.45	2.22
16. I am worried I won't learn all of the things I'm supposed to in science.*	2.59	2.31
17. I get embarrassed in science.	1.60	1.61
Summed Agreement Score* **	**86.51**	**88.68**

NOTE: *** ***p*< .001,** ** ***p* < .01,** * $p < .05$

At post-test (Appendix C), students were also asked, "did participating in the symposium impact your understanding of the scientific process and what it's like to do science research? Explain your answer." Responses were coded as 'yes,' 'no,' 'maybe/uncertain,' 'unclear from response,' or 'no response.' They were also asked to complete the statements, "before the student research symposium I thought…" and "But now I know…" All responses to open-ended items were thematically organized for reporting.

Below we report on significant[8] differences that emerged between pre-test and post-test and by demographics in the student survey results. These differences were identified in statistical tests comparing means across groups and points in time.[9] We also report on significant differences in the degree of change over time by demographics.[10] Where we refer to students "agreeing" or "disagreeing" with a particular statement, we are referring to those who responded 5 'agree' or 6 'strongly agree,' or 2 'disagree' or 1 'strongly disagree,' without reverse coding. "In the middle" refers to students who responded 3 'disagree a little' or 4 'agree a little.'

Overall Pre-Post Results

Students generally assessed their interest and self-efficacy in science highly at pre-test. (Table 2 above.) Most positively worded items averaged between 'agree' and 'strongly agree,' with the exceptions of "I am able to conduct peer review of other students' science research," "I am able to construct scientific arguments," and "I want to have a career in science someday," which still averaged above the midpoint between 'slightly agree' and 'agree.' Most of the negatively worded items (for which disagreement is a better result) averaged between 'slightly disagree' and 'disagree' except for "I get embarrassed in science," which averaged above the midpoint between 'disagree' and 'strongly disagree.'

Analysis of the pre-test and post-test student survey data found a statistically significant positive change on the summed agreement score of all items.[11] Out of a maximum possible summed score of 102, the average summed score was 86.51 at pre-test and 88.68 at post-test. The most statistically significant changes were on the following items, all associated with science self-efficacy[12] (Table 2 and Figure 7):

- **I am able to learn new things in science.**
    - Percentage responding 'agree' or 'strongly agree' increased from 93% to 95%; percentage responding 'strongly agree' increased from 60% to 75%.
- **I am able to ask good questions to do science research.**
    - Percentage responding 'agree' or 'strongly agree' increased from 70% to 83%; percentage responding 'strongly agree' increased from 35% to 41%.
- **I am able to interpret data in science research.**
    - Percentage responding 'agree' or 'strongly agree' increased from 75% to 83%; percentage responding 'strongly agree' increased from 33% to 46%.
- **I am able to conduct peer review of other students' science research.**
    - Percentage responding 'agree' or 'strongly agree' increased from 69% to 77%; percentage responding 'strongly agree' increased from 31% to 45%.

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[8] $p < .05$

[9] T-tests and Analyses of Variance (ANOVAs). See Appendix A.

[10] Mixed between-within ANOVAs. See Appendix A.

[11] $t(126) = -4.743$, $p = 0.000$.

[12] $t(140) = -3.732$, $p = 0.000$; $t(140) = -2.965$, $p = 0.004$; $t(138) = -2.632$, $p = 0.009$; $t(140) = -2.747$, $p = 0.007$.

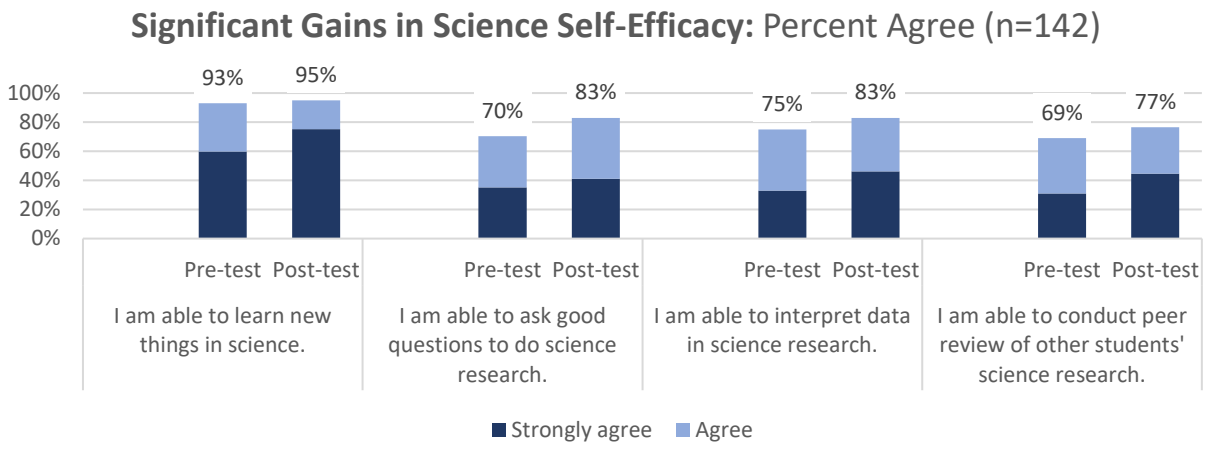

Figure 7. Significant improvement on student survey items related to science self-efficacy between pre-test and post-test.

There were also positive changes on the following at a lower level of significance:[13]

- I am able to construct scientific arguments.
- I am good at science.
- I am proud of my accomplishments in science.
- I get angry when I don't understand something in science. (Decreased.)
- I am worried I won't learn all of the things I'm supposed to in science. (Decreased.)

Of 116 students (82%) who responded to the open-ended post-test question, "did participating in the symposium impact your understanding of the scientific process and what it's like to do science research?" 79% responded that it did, 5% percent responded that it did not, and the remainder fell into the 'maybe/uncertain' and 'unclear from response' categories. Asked to explain their answers, many comments described gaining both general and specific knowledge in a variety of areas (26), for example, "Yes, I better understand how to test water quality," (6th grade student, Northeast) and "Yes, we learned more about pH." (6th grade student, Southwest). Some also remarked on learning from other student presentations and the peer review process, such as a 5th grade student from the Northeast region who said, "Yes because all of the posters taught me something new," as well as others:

I've never done research on this level or been to an event like this so I learned a lot about the research and review process. -10th grade student, Northeast

Yes, I liked the non-competitive atmosphere, I learned more about collaboration. -12th grade student, Midwest

Yes, because I got to learn from others including scientists and other students. -10th grade student, Midwest

[13] $t(140) = -2.001$, $p = 0.047$; $t(138) = -2.322$, $p = 0.022$; $t(139) = -2.495$, $p = 0.014$; $t(138) = 2.441$, $p = 0.016$; $t(139) = 2.258$, $p = 0.025$.

Twenty-one comments focused on gaining new science and research skills, for some even after repeat SRS attendance, for example:

> *It gave me a better understanding of all aspects of science.* -9th grade student, Southwest
>
> *I enjoyed using new tools to find and collect data. There were many aspects to the data collection I thought were interesting.* -9th grade student, Northeast
>
> *Yes it did. As always, it gives me a better view of science. Every symposium gives me more knowledge of science.* -6th grade student, Northeast

Yes, it impacted my understanding of the scientific process and what it's like to do science research. It gave me a better perspective on science. -8th grade student, Southeast

Seven comments focused specifically on building presentation skills and confidence. "Yes, it did help because I learned about presenting my research and project in front of many people," commented a 6th grade student from the Midwest region, and an 11th grade student from the Pacific region commented "Yes, I learned how to properly present science."

Participants described being inspired and having fun at the event (21). Some were inspired to pursue careers in science or to engage in new scientific research projects.

Participating in this year's SRS has given me more inspiration and ideas on the scientific process. Doing science research for my project was fun and interesting. -10th grade student, Southwest

> *Yes, this event verified that I have a passion for research, and that I will definitely pursue research in college.* -11th grade student, Midwest
>
> *YES! I've learned soo* [sic] *much today and it really gave me more inspiration and more topics to think about in future research.* -11th grade student, Midwest

Another major theme to emerge was learning about science, including the scientific process and the value of science, outside the classroom (18).

> *The symposium helped me realize what sharing your research is like. We aren't usually taught that sharing is part of the process until later on ...* -10th grade student, Northeast
>
> *Yes, most labs we do in school already have correct answers, for this research it wasn't predetermined.* -8th grade student, Northeast

Yes, I began to realize the importance of science and research in our lives. The research symposium left a big impact on my life. -10th grade student, Midwest

This included a subtheme about being a scientist. Several students remarked on feeling like a 'real scientist' or professional, for example, "It really gave me a feel of a legitimate science presentation. I felt like a real scientist," (11th grade student, Pacific) and "Yes it did. I got a taste of what it is like at the professional level," (7th grade student, Northeast). Another commenter described the scientist identity in inclusive terms: "Yes, it shows that everyone and anyone can be a scientist and that we all have different perspectives," (9th grade student, Pacific).

Ten participants described the event as having no impact because of their prior scientific knowledge, previous exposure to science or specifically to the SRS, or for individual reasons.

Students were also asked to complete the statements, "before the student research symposium I thought … but now I know …" and 126 (89%) responded. Many of their 'before … after' statements illustrate how the SRS increased their confidence to participate in science (20), such as "I was bad at science anything. … I am capable of science," (9th grade student, Southwest) and "others would outshine our group … we are all equals here," (11th grade student, Pacific). An English language learner stated:

> *I won't make it because my English not really good, scientist will ask me a question and have a big word in science, that I don't understand. … Even though, my English is not good, I still can learn a lot from the science.* -11th grade student, Southeast

Many commenters (20) described gaining skill and confidence specifically in presenting, for example:

> ***[Before the SRS I thought] that presenting was going to be scary and nerve-racking … [Now I know] presenting is just explaining what you know to others.*** -10th grade student, Midwest

> *I thought that I couldn't do it but, I boosted my confidence and went for it. … I know that when I get nervous, focus on the presentation.* -5th grade student, Midwest

> *I would have a difficult time explaining my project to the reviewers/students. … How to calm my nerves and express my ideas.* -10th grade student, Northeast

> *I thought that I wasn't going to remember what to say. And I was nervous. … that it wasn't as bad as it seemed and that it was fun presenting to other people.* -5th grade student, Southeast

Many students were especially anxious about the process of presenting to the reviewers, but grew to understand the benefits of knowledgeable feedback and constructive criticism (10):

> *That it'd be a lot harder to present and that it may be a lot more critical. … Presenting actually isn't that bad and criticism given is helpful and friendly.* -10th grade student, Midwest

> *I was going to do horrible in my presentation. … That the scientists are there to hear your ideas, not criticize them.* -9th grade student, Southwest

> *That presenting research to others is scary. … It's okay because people aren't going to judge you or yell at you.* -8th grade student, Northeast

> *The presenting process would be scary. … It wasn't scary at all and everyone was nice.* -8th grade student, Northeast

Some students described coming into the event doubting the quality or value of their research projects (9), but left with a very different perspective on their own projects and research more broadly:

> *My project was dumb and a waste of time. … My project is important in vegetable garden research.* -11th grade student, Midwest

That my research wouldn't have an impact and that it wasn't good enough. … That no matter what, how big or small, research, and the pursuit of answers will always be beneficial! -11th grade student, Midwest

Research and data is insignificant as compared to innovation and engineering. … Innovation cannot exist without research, new information, and experiments. -8th grade student, Southeast

One commenter in this category was pleased to learn that others shared what was considered an unusual scientific interest: "Not many people liked worms all that much. … I'm not alone in loving the little squishy creatures," (10th grade student, Southwest).

Although three students found the SRS more stressful than they expected, eleven found it less stressful and more enjoyable than they expected, as they described it:

It would be extremely difficult and scary. … It's very exciting [and] helpful. -9th grade student, Southeast

That all science fair type things would be very competitive. … Communication and collaboration makes for a better learning experience. -12th grade student, Midwest

That this would be very nerve-racking and filled with anxiety. … GLOBE is a very comfortable environment that allows me to learn. -11th grade student, Pacific

Another major theme was anticipating that the SRS would be tedious or boring, but coming away from the event exhilarated about GLOBE and about science, and wanting to do more (25):

[Before the SRS I thought] that I wouldn't want to do GLOBE and that I wouldn't learn anything new. … [Now I know] that GLOBE is about having fun and learning new things and that I want to come back to GLOBE. -6th grade student, Southwest

I thought it was going to be boring … it was a fun experience and I enjoyed seeing other people's presentations. -11th grade student, Pacific

Before the symposium I wasn't very interested in the field of science or what it had to offer me personally. … The scientific area can now help me learn, explore, and it can help impact my life in many ways. -10th grade student, Southwest

I thought that there would be a lot of lectures and minimal activities that required audience participation. … Now, I know that this event (for these past 2 days) were very engaging, enjoyable, and will be part of my best memories yet. I would recommend this type of research and projects to every student. -11th grade student, Midwest

Results by Demographics

In this section, student survey data are analyzed by student demographics, including gender, race and ethnicity, household income, and grade. Student demographics were reported via the parent and guardian student registration survey and matched to survey data using student registration numbers.

Gender

Overall, gender did not seem to be an important factor in survey results. There was a significant difference in how the responses of female and male students changed between pre-test and post-test on one item: "I am worried I won't learn all of the things I'm supposed to in science." Female students

were *more worried* at pre-test, agreeing or in the middle with the statement more (46%) than male students (30%). The percentage agreeing or in the middle decreased for female students by post-test (34%) while staying level for male students (30%). On the scale of agreement from 1 to 6, the average for female students was 2.69 and the average for male students was 2.25 at pre-test; by post-test, it was 2.25 for female students and 2.38 for male students.[14] (Figure 8.) Although the percentage agreeing or in the middle (indicating more worry) was still lower among male than female students at post-test, the strength of their agreement increased slightly from pre-test to post-test, resulting in the higher average.

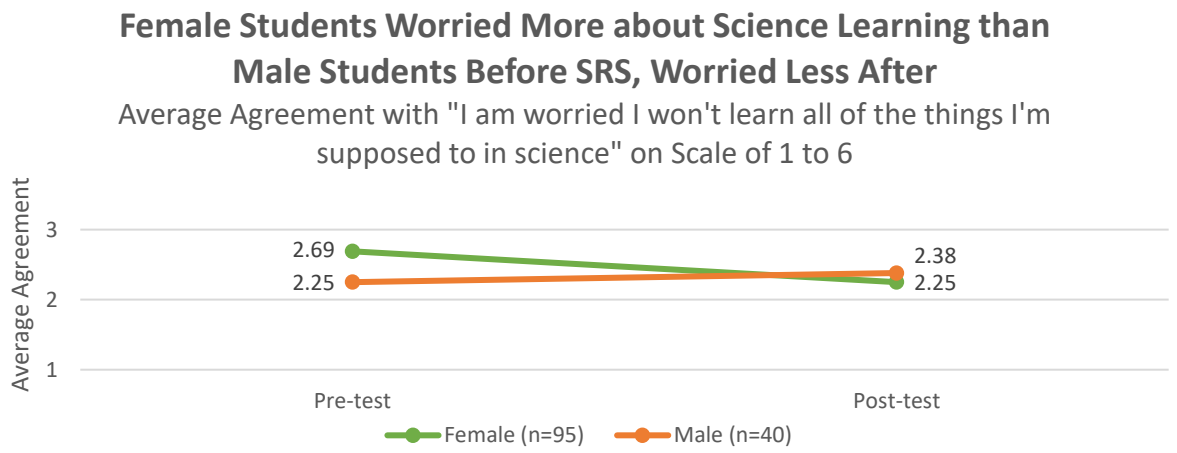

Figure 8. Student worry about science learning by gender from pre-test to post-test.

Race/Ethnicity

The race/ethnicity groups for students of color in the matched pre-post sample were small and imbalanced in size. Therefore, findings should be interpreted with caveats. Some differences may not have been detected, and the findings may not be generalizable beyond the sample. The American Indian or Alaska Native and Asian/Pacific Islander categories had to be merged into the multiple ethnicity/other category due to low numbers in the sample. Although there were no significant differences by race/ethnicity on the summed agreement score, differences were found on two individual items.

- At pre-test, students in the Multiple Ethnicity/Other category agreed or were in the middle significantly more (69%) than white students (39%) and Hispanic American students (17%) with the statement "I am worried I won't learn all of the things I'm supposed to in science," indicating that they *worried more.* A significant difference was found at post-test as well (69% compared with 26% and 28% respectively).[15] Black or African American students agreed or were in the middle at a rate of 41% at pre-test and 35% at post-test.
- Black or African American students (59%) agreed less than white students (82%) with "I am able to interpret data in science research" at pre-test.[16] This difference emerged as significant in a secondary test only; the overall test of difference across groups neared but did not meet the cutoff for significance. Therefore, this result should be interpreted as descriptively notable rather than conclusive. The difference was no longer significant at post-test. (Figure 9.)

[14] $F(133) = 4.242$, $p = 0.041$, $\eta^2 = 0.031$.
[15] $F(3) = 3.838$, $p = 0.011$; $F(3) = 4.292$, $p = 0.006$.
[16] $F(3) = 2.590$, $p = 0.056$; Tukey $MD = 0.539$, $p = 0.042$.

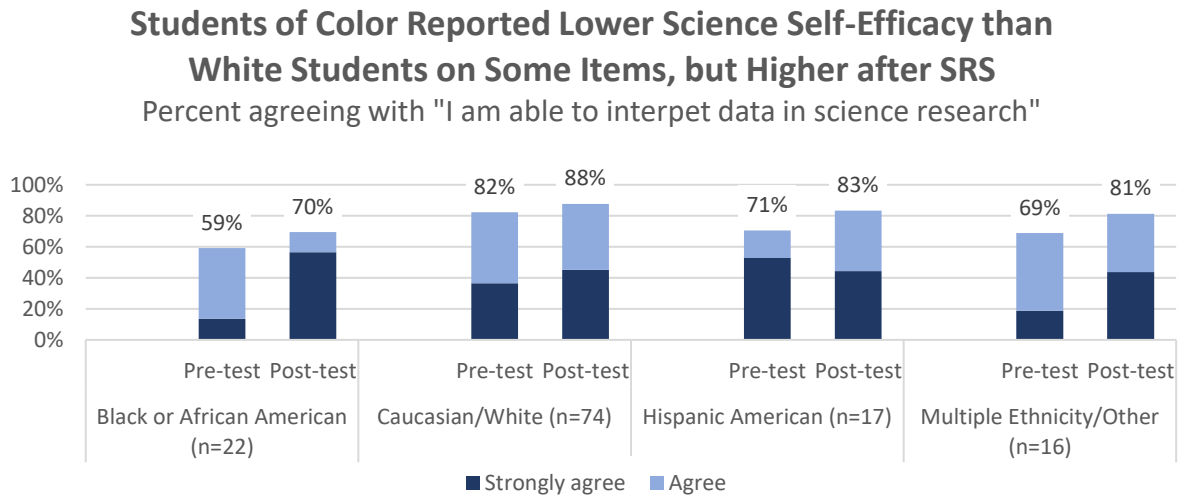

Figure 9. Student ability to interpret data in science research at by race/ethnicity at pre-test and post-test.

Income

Household income as reported by parents and guardians was coded into three categories so there would be an approximately equal number of cases in each category for analysis: $0 - $49,999, $50,000 - $99,999, and $100,000 and up. Differences emerged on multiple individual survey items as well as the summed agreement score. However, as many parents and guardians preferred not to share their household income, group sizes were again small – some differences may not have been detected.

- There was a significant difference on the average summed scale score at pre-test with a gap of over seven points between the low-income group (85.19) and the high-income group (92.63).[17] This gap narrowed and became statistically insignificant by post-test. (Figure 10.)

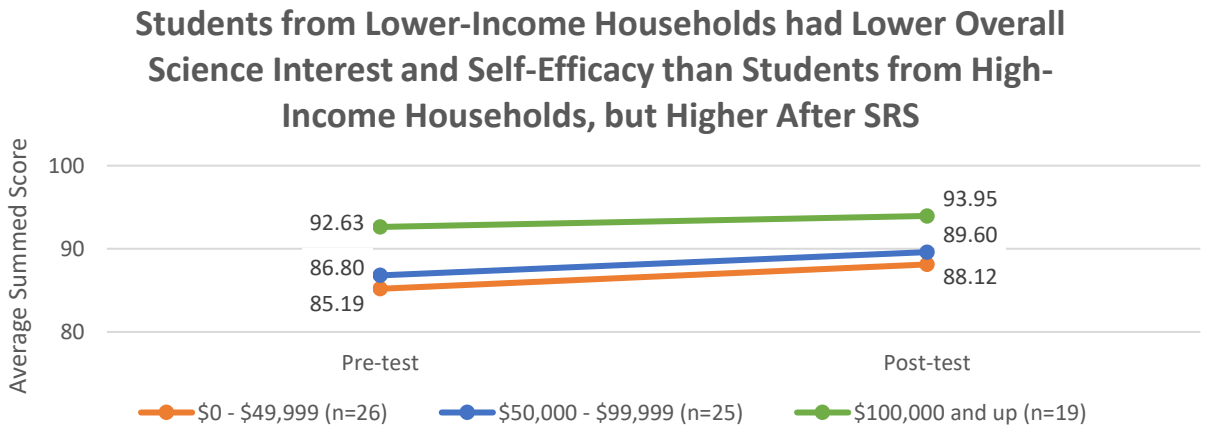

Figure 10. Average summed agreement scores by household income from pre-test to post-test.

[17] $F(2) = 4.324$, $p = 0.017$.

- There was a significant difference at pre-test only in agreement with the statement "I enjoy science." Students in the low (90%) and middle (85%) income groups both agreed less with the statement than students in the high-income group (95%), and the difference between the middle- and high-income group was statistically significant.[18] Rates of agreement were high for all three groups at both time points, however, ranging from 85% to 100%.
- There were significant differences at pre-test only in agreement with the statement "I am worried I won't learn all of the things I'm supposed to in science" (Figure 11) as well as with "I get embarrassed in science." In both cases, students in the low-income group agreed or were in the middle more frequently with the statement (52%, 23%), indicating that the low-income group *worried more* about learning all the things they are supposed to in science, and were *more embarrassed* in science, than the high-income group (24%, 0%).[19] Although there were still differences in these percentages at post-test, they were no longer statistically significant.

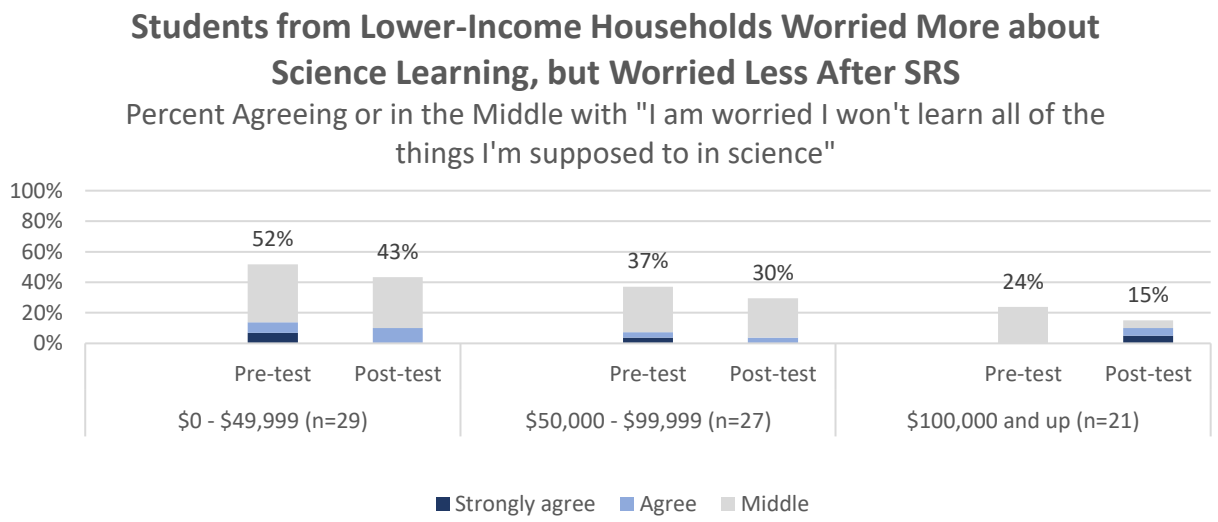

Figure 11. Student worry about science learning by household income at pre-test and post-test.

- There were significant differences at post-test only in agreement with the statements "I am able to ask good questions to do science research" and "I am able to analyze data to do science research." In response to the first, the low-income group agreed slightly less with the statement (77%) than the high-income group (81%) at pre-test. In response to the second, the middle-income group agreed slightly less (89%) than the high-income group (91%) at pre-test.[20] In both cases, the group compared with the high-income group did not experience an increase in agreement between pre-test and post-test while the high-income group increased to 100%, resulting in the difference at post-test only.
- There was a significant difference at post-test only in "I get bored in science." At pre-test, the middle-income group was the *most bored* in science based on the percentage in agreement or in the middle with the statement (26%) compared with the high-income group (10%).[21] The middle-income group agreed more at post-test (37%) than at pre-test (as did the low-income

[18] $F(2)= 3.219$, $p = 0.046$; Tukey $MD = 0.598$, $p = 0.035$.
[19] $F(2)= 4.647$, $p = 0.013$; Tukey $MD = 1.135$, $p = 0.010$. $F(2)= 4.302$, $p = 0.013$; Tukey $MD = 0.843$, $p = 0.017$.
[20] $F(2)= 3.336$, $p = 0.041$; Tukey $MD = 0.617$, $p = 0.031$. $F(2)= 4.144$, $p = 0.020$; Tukey $MD = 0.504$, $p = 0.019$.
[21] $F(2)= 3.612$, $p = 0.032$; Tukey $MD = 0.885$, $p = 0.028$.

group), indicating that they got *more bored* in science at the end of the SRS than at the beginning. The high-income group agreed less at post-test (5%) than pre-test, suggesting they were *less bored* in science at the end of the SRS than at the beginning.

- Income also made a difference in how responses to the statement "I am able to learn new things in science" changed over time. The middle-income group showed the steepest growth between pre-test and post-test in comparison to the high-income group, with the average increasing from 5.44 or just below the midpoint between 'agree' and 'strongly agree' to 5.78 or a little below 'strongly agree.'[22] (Figure 12.)

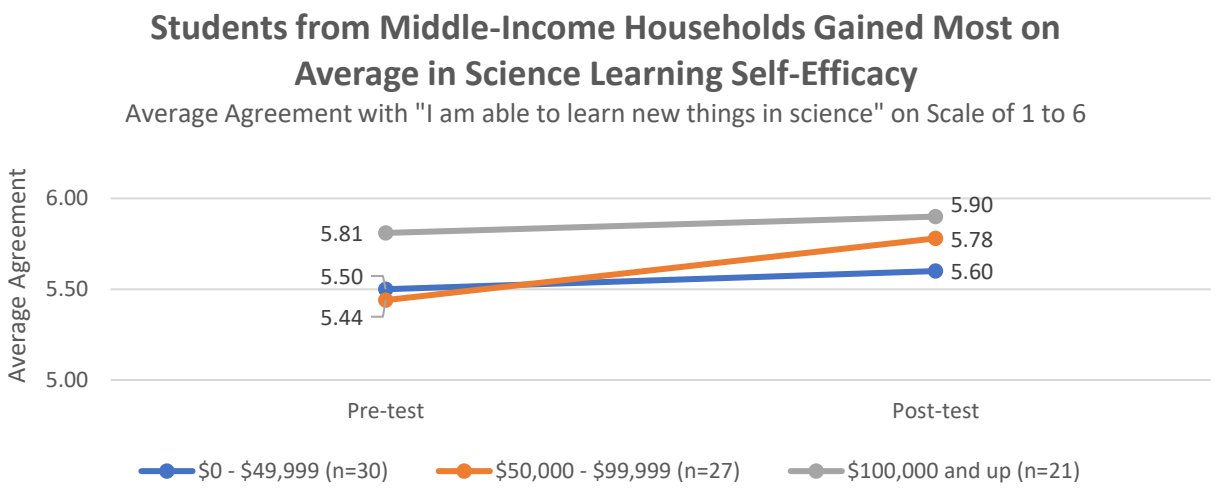

Figure 12. Average agreement with "I am able to learn new things in science" by household income at pre-test and post-test.

Grade

Several differences by grade category were identified at pre-test, but none at post-test. The three grade categories were grades 4 to 6, grades 7 to 9, and grades 10 to 12.

- At pre-test, the youngest grade group agreed significantly more with "I am good at learning new things in science" (97%) than the oldest grade group (82%).[23]
- At pre-test, the oldest grade group agreed or were in the middle significantly more (55%) than the middle (51%) and youngest (20%) grade groups with "I get angry when I don't understand something in science," indicating that the older grade groups get *angry more*.[24] The difference was no longer significant at post-test, although the percentage increased for the younger group, indicating that they get *angry more* at post-test than at pre-test. In contrast, the two older groups agreed less at post-test than pre-test, indicating that they get *angry less*.
- The oldest age group also agreed or were in the middle significantly more (54%) with "I am worried I won't learn all of the things I'm supposed to in science" than the youngest age group (22%) at pre-test, indicating that the oldest group *worried more* than the youngest group.[25] The difference was present but no longer statistically significant at post-test. (Figure 13.)

---

[22] $F(2) = 3.336$, $p = 0.041$; Tukey $MD = 0.617$, $p = 0.031$.
[23] $F(2) = 3.353$, $p = 0.038$; Tukey $MD = 0.446$, $p = 0.038$.
[24] $F(2) = 4.149$, $p = 0.018$; Tukey $MD = 0.759$, $p = 0.037$.
[25] $F(2) = 6.464$, $p = 0.002$; Tukey $MD = 1.053$, $p = 0.001$.

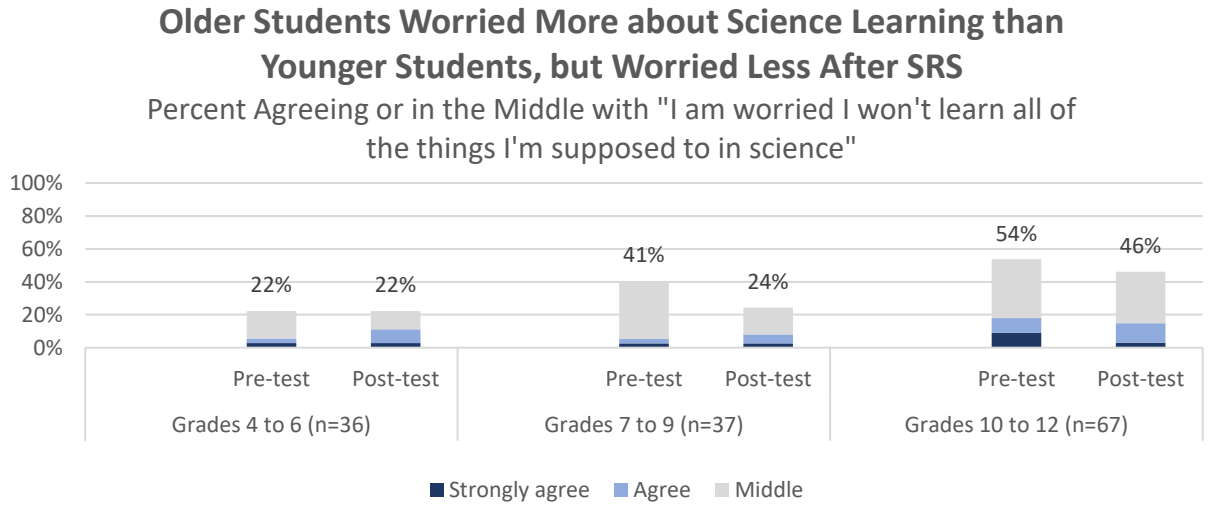

Figure 13. Student worry about science learning by grade at pre-test and post-test.

Teacher Survey Results

Teacher Survey Questionnaire

Of the 66 teachers attending the SRS, 38 (58%) participated in the post-test only teacher survey and consented to participate in research. The questionnaire (Appendix D) included subjects taught, use of GLOBE resources, and solicitations of feedback on the SRS and professional development activities. It also included scales measuring science teaching beliefs and practices; as these were related to research questions outside the scope of this evaluation, the results can be found in Appendix E. Registration codes were not requested in the teacher survey, so survey data could not be matched with registration demographics data. Please see Appendix A for more information about the teacher survey sample.

Teachers were asked what subjects they teach and invited to select multiple subjects, resulting in a total of 86 selections for the 38 respondents. The most frequently selected subjects were earth science (14), environmental science (11), biology (11), physical science (10), and chemistry (9). Eighteen wrote in an 'other' subject. These included, for example, engineering (3), oceanography (1), and urban ecology (1). Three reported that that their primary content expertise is not related to STEM. (Table 3.) Over half (53%) reported that their GLOBE project was an out-of-school activity, 45% reported it was an in-school activity, and 3% reported 'other.'

Table 3. Teacher subjects taught in school.

Subject	Selected	Subject	Selected	Subject	Selected
Earth science	14	Chemistry	9	Other	18
Enviro. science	11	Physics	6	Not related to STEM	3
Biology	11	Gen. mathematics	3		
Physical science	10	Calculus	1		

Use of GLOBE Resources

Teachers were asked about the GLOBE resources they used prior to attending the SRS, resources their students used prior to the SRS, and resources they planned to use in the future. They were invited to select as many as applied. For resources used prior to the SRS, they were also asked to rate their helpfulness on a scale of 0 'not at all helpful' to 5 'very helpful.' (Table 4.) The resources used by the greatest numbers of teachers and students were 'consultation/support from your local Partnership' (29, 24) and 'Science Practices resource pages' (19, 15), and both were highly rated for their helpfulness (the latter more so for students than for teachers). The remainder were highly rated too, but not used by as many teachers and students. The resources the greatest number of teachers planned to use in the future included the two used most prior to the SRS, 'Science Practices resources pages' (33) and 'consultation/support from your local GLOBE Partnership' (29), as well as 'Teacher Webinars' (23).

Table 4. Teachers use of GLOBE resources prior to the SRS.

Resource	Teachers used (n=38)	Teachers rated helpful or very helpful for themselves	Students used as reported by teachers	Teachers rated helpful or very helpful for their students	Teachers plan to use in the future
Consultation/support from your local GLOBE Partnership	29	29/29	24	23/24	29
Science Practices resource pages (located on internal GLOBE webpages)	19	15/19	15	14/15	33
Weekly list serve updates (email)	16	15/16	4	3/4	18
October 9, 2018 Teacher Webinar: SRS 2019 Overview with Jennifer Bourgeault	6	6/6	3	3/3	N/A
Teacher blog posts	5	5/5	2	2/2	11
February 20, 2019 Teacher Webinar: How to Upload Your Data with Cornell Lewis	4	3/4	0	0/0	N/A
Teacher Hotline	2	2/2	N/A	N/A	7
Teacher Webinars	N/A	N/A	N/A	N/A	23

Professional Development

Thirty-two of the 38 teachers (84%) reported that they had participated in a professional development activity while at the SRS. They were asked how often they felt as described in a series of statements during the professional development activity, rating each 0 'never,' 1 'once or twice,' 2 'seldom,' 3 'sometimes,' 4 'most of the time,' or 5 'always.' Average ratings for all positively worded items were between 'most of the time' and 'always,' indicating they generally found the activity useful, relevant, and interesting, and anticipated that it would help improve their teaching. The negatively worded item 'the task was too difficult' had an average rating near 'never.' (Table 5.)

Table 5. Teacher feedback on professional development activity at the SRS.

Statement about Professional Development Activity	Average Rating	Rounded Scale Point Label
Interested in the task	4.56	Always
That GLOBE materials presented were relevant	4.50	Always
That GLOBE materials presented were useful	4.48	Most of the time
Eager to learn more about the topic	4.35	Most of the time
That what you learned will help you be a better educator	4.25	Most of the time
That you will be able to implement what you learned	4.16	Most of the time
The task was too difficult	0.16	Never

Teachers were asked to suggest improvements for the professional development experience, and 17 responded. Eight responses from teachers in multiple regions offered a range of suggestions, including:

- More options for PD topics
    - Water qualities, oil resistance, trees and carbon, NIOSHA, the B/Moor Cool Project
- Sample class by a professor on GLOBE-related activities
- More SMEs (subject matter experts)
- Allow participants to have materials loaded on to a flash drive
- Experiential PD, interactive PD with GLOBE Partners
- Submitting written questions for presenters to answer orally
- Reflecting on supports, not content
- More time to chat with other educators about teaching "tricks" and strategies

Of these eight suggestions, two addressed the scheduling of activities:

> *I actually think PD would have been more useful during the students' ice breaker activities and/or in the afternoon because I was interested in supporting my students during their poster presentations, which took priority over the PD for myself.* -Teacher, Northeast

> *Thank you! It was awesome! It would have been great to get the students out collecting data right at the Beach Camp – but I know.* -Teacher, Northwest

Four additional responses, all from the Southwest region, suggested more content related to the GLOBE protocols. Two of these requested training for the GLOBE protocols, apps, and websites, and a third similarly suggested "Please provide GLOBE training. I would love to learn the protocols or more tips on how to facilitate projects, scientific writing." The fourth combined the same suggestion with praise, commenting "I would have liked better to hear about how to do protocols that I am unfamiliar with. Great experience!"

The remaining comments offered praise for the PD and the SRS more generally, such as "I think it was great! Thanks! [Smiley face.]" (Teacher, Pacific), and "These regional symposiums are something which are transformative for all who participate!" (Teacher, Midwest). A teacher from the Northeast explained, "P. Anderson's lesson was excellent. I made connections between concepts that increased my understanding of weather that I can now pass onto my classes."

Impact of the SRS

Asked if participating in the SRS improved their ability to integrate science research into their classroom or program, 32 of 36 teachers in the sample (84%) said "yes." Their comments in response to an open-ended follow-up question (28) often focused on new approaches or ideas for teaching (15), for example:

"It has made me feel more confident in asking the questions and giving the students more time to discuss and/or explain themselves. Stop rushing them and let them be more creative." – Teacher, Midwest

I feel I'm gaining a better understanding of how to help students come up with questions, analyze data, and use statistics to analyze. -Teacher, Pacific

Seeing the final product then having this in mind while teaching really helps me push the students to produce better quality research. -Teacher, Pacific

Talking to other teachers and students about their projects help me find new things/activities to do in class with my students. -Teacher, Northeast

"I really learned how to better facilitate scientific writing. I am looking forward to expanding next year. I loved this project!" – Teacher, Southwest

However, one commenter from the Southwest region inquired about the SRS "alignment to common core standards." Another from the Northeast expressed the concern, "I have overcrowded rooms (average 24 students) and I don't have the time that I need to develop these resources."

Seven comments described what the teachers themselves learned about, including three referencing GLOBE and the resources offered, such as "all of the resources available from GLOBE are thorough, reliable, and easily accessible. It is especially helpful to have a lot of visual aids to download and print FOR FREE!" (Teacher, Northeast). Another, also from the Northeast, raved, "I loved Bruce Anderson's vocal weather forecasting... LEARNED A LOT! He has an excellent way to teach!"

Two comments focused on the impact of the SRS on their students, stating "it gives my students an opportunity to see science careers in action," (Teacher, Midwest) and "it helps my student realize they can do real science that matters," (Teacher, Northeast). And one simply summarized, "always well done!" (Teacher, Midwest).

Satisfaction with the SRS

Students and teachers were asked about their satisfaction with the 2019 GLOBE SRS. Overall, they reported positively on their experiences.

- The student post-test survey asked which SRS events they enjoyed the most, and which they enjoyed the least. They were invited to select multiple events. The 142 students included in this report made many more selections of events they enjoyed the most (601) compared to events they enjoyed the least (165). (Figure 14.)
- The SRS events selected by students as those they enjoyed most involved interaction with scientists. Meeting scientists was selected most frequently (84), followed by review from scientists (82), and research presentations to the reviewers (77).

- The SRS events selected by students as the events they enjoyed the least involved sitting and listening to speakers rather than active participation. The keynote speaker was selected most frequently (21) followed by the opening remarks (20).
- Events involving interactions with other students fell in the middle. Meeting other students was selected as enjoyed the most by 63 and the least by 15, research presentations to other students was selected as enjoyed the most by 54 and the least by 12, and peer review from students was selected as enjoyed the most by 51 and the least by 18.

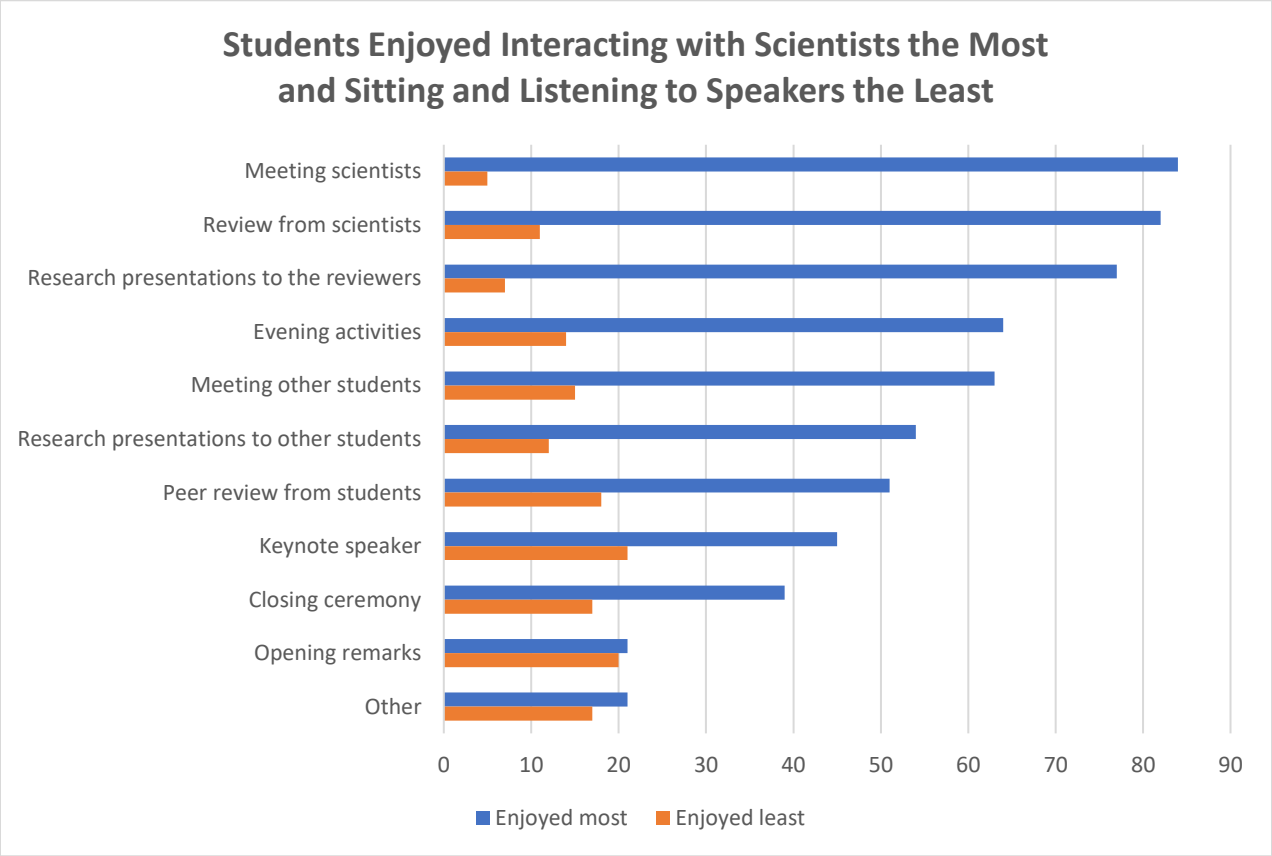

Figure 14. SRS events enjoyed the most and the least by student participants.

- Teachers were asked to rate their satisfaction with the SRS for themselves and for their students, and with specific SRS events, on a scale of 1 'very dissatisfied' to 6 'very satisfied.'
    - Ninety-two percent were satisfied (40%) or very satisfied (53%)[26] with the SRS for themselves, and 92% were satisfied (30%) or very satisfied (62%) for their students.
    - For most of the specific SRS events, approximately 90% or more were satisfied or very satisfied. Topping the list at 97% satisfied (35%) or very satisfied (62%) was review from scientists. At the lower end of the scale but still with high ratings of satisfaction were the keynote speaker (86%), the opening remarks (85%), peer review from other students (82%), and evening activities (79%). (Figure 15.)

[26] Total exceeds 92% due to rounding.

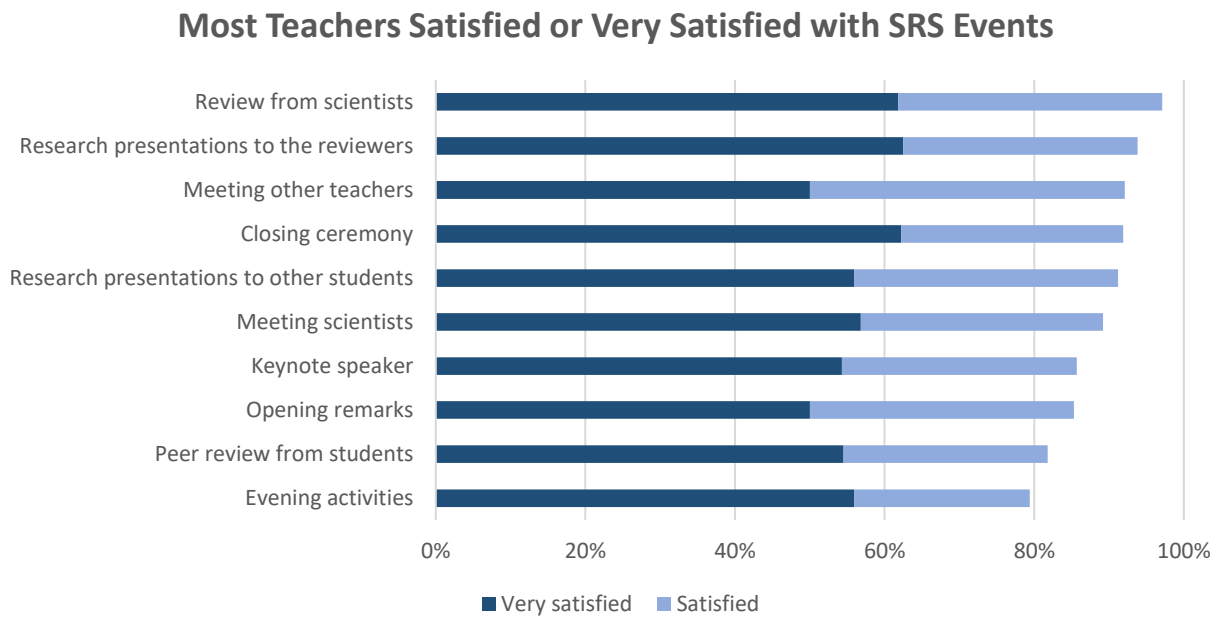

Figure 15. Percentage of teachers 'satisfied' or 'very satisfied' with SRS events.

Teachers were asked to explain their level of satisfaction with the SRS experience for themselves or their learners, and 33 responded. Eighteen comments were exclusively positive and came from teachers new to the SRS as well as returning teachers, such as "It was a great first time experience!" (Teacher, Southeast), "I love this and this is my 3rd year. It's great to see how it's grown!" (Teacher, Pacific), and "It was a great learning experience. One of the best I have attended so far," (Teacher, Southwest). One first-time attendee expressed:

> *This is my first SRS and my entree, officially, to GLOBE. I'm excited to grow into a GLOBE teacher. The SRS marks an important step.* -Teacher, Northeast

Others offered general praise, exclaiming, "This has been such an incredible, positive experience!"(Teacher, Pacific) and "GLOBE and everyone involved and associated with GLOBE is wonderful and amazing!" (Teacher, Northeast). Praise for more specific aspects of the SRS include:

> ***This is a great real world experience for the students. They see a very high level of peer research and have an opportunity to present for STEM professionals.*** -Teacher, Southwest

> *I enjoyed the presentations to the teachers and was thrilled by how excited the students were after meeting with the scientists.* -Teacher, Northeast

> *The experience was wonderful and informative; overall, a fantastic experience for the kids. Excellent location where the kids were both able to learn and have fun.* -Teacher, Northwest

> *Thank you for having us. The students and myself had a great time! I also enjoyed meeting other teachers and discussing our projects.* -Teacher, Northeast

Two teachers noted the SRS as an important opportunity for girls to foster enthusiasm for science. One teacher from the Northeast commented, “This is an incredible opportunity for me to encourage girls' interest in science and keep them motivated.” Another explained:

> *I absolutely love the obvious care and attention, passion put into this event. I have been impressed with the investment the officiates have put into my students and their experience. I am excited at the opportunities my girls have been exposed to. I really appreciate this opportunity and those who have made it possible.* -Teacher, Southeast

One teacher from the Pacific region remarked that "this year cultural relevance significantly improved,” and thanked the organizers for “Not having a lecture during dinner, having women of color scientists present, having a chant asking permission to use the space from Hawaii Students,” concluding that it was a “phenomenal experience for all!”

Five comments were mixed, offering general praise for the event while also noting issues that arose such as a non-constructively critical expert reviewer and problems with transportation from the dorms to activities. These commenters as well as five others offered suggestions for improvement including:

- Fewer speakers, speakers more aligned to a younger audience
- More activities, more “doing” science
- Opportunities for teachers to view student projects
- Organized icebreakers
- Mixing up student teams for Saturday activities
- Opportunities for students to meet scientists and learn about their field of study
- GLOBE training for teachers
- Introduction to the reviewers

Examples of suggestions in their own words include:

> *The students would have benefited more if they would have been up and around doing science … with less sitting and listening.* -Teacher, Southeast
>
> *I would have appreciated a GLOBE training. This was AMAZING for my students. I wonder if there should be keynote speakers that are more aligned to a younger audience. I wonder if the students were able to meet the scientists and learn about their field of study if that would be impactful. Students could go table to table taking notes.* -Teacher, Southwest

> ***The symposium was informative and gave the students an opportunity to engage with other students. However, I did not feel that it was "student-friendly.” There were a lot of speakers, but not many activities.*** -Teacher, Southeast

Teachers were also asked for suggestions to improve the SRS objectives, schedule, or setting. Of the 26 responses, nine regarded the content or activities of the SRS, including:

- More PD, more PD options, more engaging PD
- More time for networking
- More fun, age-appropriate activities for the students
- Scientist presentations for the students

Several examples of suggestions for more age-appropriate programming came from teachers in the Southeast region:

> *I would suggest keeping the age of the participants in mind and provide age-appropriate activities within the schedule.* -Teacher, Southeast

> *Would love to explore more of the host city. Maybe coke world or aquarium. The kids worked hard - I'd like to see them play hard too. Also, maybe more hands-on learning activities, middle school learners need consistent engagement.* -Teacher, Southeast

> *-Should be kid friendly -Should not have to listen to speakers over + over -When you say you are going to do something, you should do it (attractions).* -Teacher, Southeast

Ten others regarded logistics, accommodations , scheduling, and transportation, such as:

- Detailed information packet, orientation for schedule and logistics, conference schedule app
- Staying on time and sticking to the scheduled activities
- More reliable transportation and parking passes
- Lodging closer to activity locations
- Separate rooms, more comfortable sleeping bags
- More space for family and family support
- Scheduling the SRS before AP exams and prom
- Clearer expectations for appropriate dress

Seven participants took the opportunity to offer additional praise for the SRS.

Discussion & Recommendations

Overall, the evaluation results paint the picture of a program that is succeeding in its objectives. Students and teachers benefit from participation in the GLOBE SRS and enjoy the events, including those participants who return for multiple years of attendance.

Results from the student survey clearly show that students participating in the SRS, who already for the most part show strong interest in science, generally experience a marked increase in their science self-efficacy as a result of the event. Their confidence to conduct and present scientific research grows as a result of practicing these skills. Their engagement with a scientific community places their projects in a larger scientific context and emphasizes the importance of collaboration and peer review in producing good research. These aspects of the SRS can be eye-opening for students, illuminating the role of science in the world and new paths in science to pursue. Students' overwhelmingly positive—and sometimes exuberant—comments about the event tell the depth of this experience. Nevertheless, 'I want to have a career in science someday' was one of only two positively worded items in the student survey to average below 'agree' at both pre-test and post-test. (The other was 'I am able to construct scientific arguments,' which still showed a significant increase pre-test to post-test.)

- Highlight: Overall, the GLOBE SRS appear to be effectively improving students' science self-efficacy, building students' confidence in the science skills that are practiced at the event, and getting students excited about science.

- Recommendation: Showcase science-related jobs at the SRS to help students think about how they can translate their science skills and self-efficacy into interesting career paths. Make efforts to recruit diverse representation of teachers, scientists, and reviewers so that all students can see themselves as future science professionals.

Worry about science learning decreased over the course of the SRS for participants as a whole. The average at both points in time on 'I am worried I won't learn all of the things I'm supposed to in science' was between 'slightly disagree' and 'disagree,' moving closer to 'disagree' by post-test, yet this is the least disagreement of any negatively-worded item. Perhaps it is predictable that students very engaged in science would be concerned about keeping up with their science education. However, analysis of the item by student demographics showed how this worry varied significantly by gender, race/ethnicity, age, and income. Female students, older students, students from low-income households, and some students of color indicated more worry about science learning than their counterparts. To an extent, participation in the SRS mitigated this worry and narrowed gaps between demographic groups. We may hypothesize that differences in access to resources for classroom and experiential science learning and proximity to the college admissions process accounts for some of the differences discovered, but further investigation is needed to understand these issues and their intersectionality.

- Highlight: To an extent, participation in the SRS helped to reduce worry about science learning.
- Recommendation: Investigate the specific reasons for worry about science learning among the most affected groups of students to better understand how to address these concerns.

Other than worry about science learning, few differences by gender, race/ethnicity, and age were identified in the demographic analysis. This may be partially due to small and imbalanced samples. However, even with these limitations, household income emerged as an impactful demographic variable. Significant differences were found in the summed agreement score of science interest and self-efficacy items; enjoyment of science; confidence in asking good questions, analyzing data, and learning new things in science; worry about science learning; embarrassment in science, and boredom in science—and for all the averages, students from low- and middle-income households were disadvantaged at pre-test and/or post-test compared with students from high-income households. Regarding boredom in science, students from low- and middle-income households were more bored at the end of the SRS than at the beginning, representing the only item that trended the undesirable direction, while students from higher-income households started out less bored than students from lower-income households and got even less bored over time. On the flipside of this coin, low- and middle-income students experienced greater benefits than high-income students from attending the SRS as evidenced by changes from pre-test to post-test on many, but not all, of these items.

- Highlight: Students from low- and middle-income households experienced some significant benefits in science self-efficacy and reduced worry about science learning from the SRS.
- Recommendation: Provide as much support for science engagement and experiential learning (mentoring, equipment grants, scholarships, travel support, etc.) as feasible to GLOBE low- and middle-income community partner schools, not just at the SRS but throughout the year, to help mitigate income-based differences in science interest and self-efficacy. Ensure that students from low- and middle-income schools have access to the same opportunities, activities, and amenities as their high-income peers throughout the SRS event weekends.

Many participating teachers reported leaving the SRS with new tools, approaches, and ideas to engage students in experiential science projects and facilitate their science learning. This was accomplished not only through formal professional development, but also by seeing their students' GLOBE science projects through to their conclusion (presentation at the SRS), viewing other student projects, and interacting with other teachers and attendees. Comments generally expressed excitement about GLOBE and appreciation of the opportunities offered by the SRS for themselves and their students. Some teachers would like more training on the GLOBE protocols, more options for professional development, and more networking. In terms of GLOBE resources accessed prior to the SRS for teachers and students, consultation and support from local GLOBE Partnerships and the GLOBE Science Practices webpages rose to the top. The former highlights the importance of maintaining and building GLOBE Partnerships nationwide. Many teachers also planned to access the teacher webinars in the future.

- Highlight: Teachers find certain GLOBE resources offered prior to the SRS—consultation and support from local GLOBE Partnerships and Science Practice webpages—particularly helpful for themselves and their students. The professional development activities and other learning opportunities offered during the SRS help teachers expand their strategies for building student engagement in science and facilitating science learning.
- Recommendation: Offer more teacher training on the GLOBE protocols and more options for teacher professional development. Continue building and strengthening regional Partnerships.

Students and teachers were highly satisfied with the SRS. Regarding the format of the SRS, students have a clear preference for interactive experiences, particularly those involving scientists and reviewers. They strongly prefer the review sessions and activities to the opening and closing remarks and the keynote speakers. While a few students felt overwhelmed at the packed days of the event agenda, most reported that they found all the activity fun and exciting. Teachers also strongly recommended more "kid-friendly" programming throughout the event and fewer speakers. Nearly all other constructive feedback regarded logistics: scheduling of events and activities, transportation, lodging.

- Highlight: Students really enjoy the SRS, especially interacting with scientists and reviewers. Teachers are also very satisfied with the events for themselves and their students.
- Recommendation: Reduce the time students spend sitting and listening in favor of more active and hands-on learning experiences. Things happen, but plan out the details of scheduling, transportation, and accommodations as thoroughly and as early as possible, provide as much information as possible to attendees, and stick to the advance plans as closely as possible.

These recommendations are being finalized during the COVID-19 pandemic, and one now stands out as aspirational: that the GLOBE SRS continue as regional events at sites across the country when it is safe to resume this kind of activity. It is clear from the evaluation findings that the immersion of the event and the face-to-face interactions bring enormous value to the proceedings. Virtual events may bridge the gap for the time being but may not have the same impact – we do not yet have enough information to determine that. When it will be safe to hold the SRS again is unknown at this point, but it is already safe to conclude that most participating students and teachers will benefit from the experience.

Appendix A: Methods & Results Tables

This appendix provides additional detail on the student and teacher survey samples and tables of test results for student survey findings referenced in the report. As teachers only completed a post-test survey and the descriptive results are documented in the evaluation report itself, no additional teacher survey results are presented in the test tables. Please contact eleanor.jaffee@insightsevaluation.com if you have questions or comments about the evaluation methods and reporting.

Instruments

The student pre-test and post-test and the teacher post-only survey instruments were originally developed by GLOBE staff for the 2016 SRS. Significant changes were made in 2017 to focus on self-efficacy, and the 2017 versions remain in use with minor modifications. References for the supporting literature used in their development can be found in Appendix F.

Samples

Aside from the demographic section, which used all the available data collected in the GLOBE registration process, this evaluation report used samples of student and teacher registration and survey data. Inclusion was primarily related to consent to participate in research. Evaluation is considered a distinct activity from research by the University of New Hampshire Institutional Review Board (IRB) which monitors university research projects to ensure they are conducted in an ethical manner.

Program evaluation is not under the purview of the IRB. Rather, it is an expectation that program leaders and funders will collect and analyze data to gauge the effectiveness of their programs as a matter of accountability, including original data via surveys, interviews, and focus groups, as well secondary data from program records. Consent to participate in evaluation is therefore implicit in consent to participate in the program itself. According to the IRB, this is inherently different from recruiting participants for a research study to build the knowledge base in a particular subject, which may or not serve accountability purposes or offer benefits to program participants. In an abundance of caution, however, we applied the IRB standard for research for this year's analysis and reporting for evaluation purposes, excluding the demographics section (for both students and teachers) and the student survey section *Results by Demographics*; although we used the research sample of student surveys, use of the demographic data from registration was not part of the IRB approval for this year. We will be seeking this approval for research going forward.

As a result of this decision, any findings in this report may be reproduced for *evaluation* purposes with program permission; any findings *except* for the student and teacher demographics and student survey results by demographics may be reproduced for *research* purposes with program and IRB approval. As IRB guidance becomes increasingly clear on the distinction between research and evaluation activities, we may adjust our approach in the future, using all GLOBE SRS registration and survey data for evaluation purposes and seeking IRB approval only for separate research projects using the data.

Student Pre-test and Post-test Survey Samples

Pre-test survey questionnaires were completed by 226 of the 261 registered students (87%). Student assent to participate in research was collected at pre-test. Of the 226 completes, 31 were removed from the dataset prior to analysis.

- Two students had been opted out of participation in research by their parents or guardians during registration. (Pre-test questionnaires were not found for an additional two opted-out students, of which there were four in total.)
- Twenty-six students declined participation in research.
- Three had missing responses for assent to participate in research.

After these deletions, 195 student pre-test questionnaire cases remained.

Post-test survey questionnaires were completed by 197 students (75%). Of these, 30 were removed from the dataset prior to analysis.

- One had been opted out of participation in research by their parent or guardian. (Post-test questionnaires were not found for the additional three opted-out students.)
- Twenty-nine questionnaires were missing registration codes. The codes are used to link post-test data to registration and pre-test data. Without them it could not be determined if these cases met the consent/assent requirements, which are documented with parents and guardians at registration and with students themselves at pre-test. The missing codes also prevented pre-post questionnaire data matching for longitudinal analysis. Twenty-seven of the 29 questionnaires missing registration codes are presumed to result from an oversight during student pre-test survey administration at the Southwest SRS. The percentages of American Indian or Alaska Native and Hispanic American students are lower in the matched pre-post sample than at registration due to the regional demographics represented at the Southwest SRS.

After these deletions, 167 post-test questionnaire cases remained.

Remaining pre-test and post-test cases were matched longitudinally to examine change between pre-test and post-test—i.e., to learn about the impact of participation of the SRS. Fifty-three pre-tests could not be matched with a post-test questionnaire with the same registration code, and 25 post-test questionnaires could not be matched with a pre-test. This is likely due to some students being absent for the administration of the pre-test or post-test survey. Ultimately, the matched pre-post dataset of students permitted by their parents or guardians and themselves assenting to participate in research included 142 cases. The demographics of the sample differ from the demographics of full registration. (Table 6.) This may affect generalizability of results beyond the sample.

UPDATE: An additional 12 student post-test survey questionnaires were received after data entry and analysis and were therefore not included or matched to registration and pre-test data to determine consent status. However, they increase the post-test survey response rate to 80%.

Teacher Post-test Survey Sample

Teachers were administered a post-test only survey at the end of the SRS along with consent to participate in research. Forty-six of 66 registered teachers (70%) completed the post-only survey questionnaire. Of these, 38 consented to participate in research and were included in the analysis for this evaluation report. One declined to participate in research, and the remainder were missing responses for consent to participate. It is not clear why this occurred. It is possible the item was not adequately flagged in the survey administration or the questionnaire itself as requiring response.

Registration codes were not collected to link the teacher survey data with demographic data collected during registration, nor were demographics collected in the survey itself, except for SRS region. We can

determine that representation by region in the sample differs from representation in full registration. (Table 7.) This may affect generalizability of results beyond the sample.

UPDATE: An additional two teacher survey questionnaires were received after data entry and analysis and were therefore not included. However, this increases the teacher survey response rate to 73%. One of the two teachers consented to participate, and a response to consent was missing for the other.

Table 6. Student demographics at registration (n=261) and in the final matched pre-post sample for analysis (n=142).

	Registration (n=261)		Matched Pre-Post (n=142)	
	n	%	*n*	%
Region				
Midwest	36	13.8%	28	19.7%
Northeast & Mid-Atlantic	79	30.3%	37	26.1%
Northwest	10	3.8%	--	--
Pacific	71	27.2%	37	26.1%
Southeast	26	10.0%	23	16.2%
Southwest	39	14.9%	--	--
Missing	0	0.0%	--	--
Grade				
4 to 6	74	28.4%	37	26.1%
7 to 9	69	26.4%	37	26.1%
10 to 12	118	45.2%	67	47.2%
Missing	0	0.0%	--	--
Gender				
Female	157	60.2%	97	68.3%
Male	99	37.9%	40	28.2%
Prefer not to answer	--	--	--	--
Missing	--	--	--	--
Race/ethnicity				
American Indian or Alaskan Native	16	6.1%	--	--
Asian/Pacific Islander	13	5.0%	--	--
Black or African American	28	10.7%	23	16.2%
Caucasian/White	130	49.8%	74	52.1%
Hispanic American	52	19.9%	18	12.7%
Multiple ethnicity/other	10	3.8%	--	--
Prefer not to answer	12	4.6%	10	7.0%
Missing	0	0.0%	--	--
Household income				
$0 - $25,000	26	10.0%	19	13.4%
$25,000 - $49,999	45	17.2%	19	13.4%
$50,000 - $74,999	35	13.4%	19	13.4%
$75,000 - $149,999	45	17.2%	29	20.4%
$150,000 and up	21	8.0%	--	--
Prefer not to answer	89	34.1%	49	34.5%
Missing	0	0.0%	--	--

NOTE: Data suppressed for under 10 cases.

Table 7. Teacher demographics at registration (n=66) and in the post-only survey sample (n=38).

	Registration (n=66)		Post-Only Survey (n=38)	
	n	%	*n*	%
Region				
Midwest	--	--	--	--
Northeast & Mid-Atlantic	20	30.3%	14	36.8%
Northwest	--	--	--	--
Pacific	13	19.7%	--	--
Southeast	--	--	--	--
Southwest	14	21.2%	--	--
Missing	0	0.0%	0	0.0%
Gender				
Female	47	71.2%		
Male	16	24.2%		
Other	--	--		
Missing	--	--		
Race/ethnicity				
American Indian or Alaskan Native	--	--		
Asian/Pacific Islander	--	--		
Black or African American	--	--		
Caucasian/White	53	80.3%		
Hispanic American	--	--		
Missing	--	--		

NOTE: Data suppressed for under 10 cases.

Test Tables

Results are presented for all findings referenced in the report. All significant results are reported. The pre-post matched sample of n=142 was used for analysis with SPSS Statistics for Windows, version 26.[27]

Table 8. Paired Samples t-test: Average agreement with all science attitudes and self-efficacy statements pre-test to post-test.

Paired Samples t-test								
	M(pre)	*M*(post)	*M*	*SD*	*t*	*df*	*p*	Cohen's *d*
I am able to learn new things in science.	5.51	5.69	-0.177	0.564	-3.732***	140	0.000	0.319
I am able to earn a good grade in my science classes.	5.48	5.53	-0.057	0.427	-1.577	140	0.117	0.117
I am able to ask good questions to do science research.	5.01	5.18	-0.177	0.710	-2.965**	140	0.004	0.239
I am able to analyze data to do science research.	5.24	5.34	-0.107	0.707	-1.794	139	0.075	0.141
I am able to interpret data in science research.	5.02	5.22	-0.201	0.902	-2.632**	138	0.009	0.222
I am able to construct scientific arguments.	4.82	4.96	-0.142	0.842	-2.001*	140	0.047	0.166
I am able to conduct peer review of other students' science research.	4.89	5.12	-0.227	0.981	-2.747**	140	0.007	0.234
I am good at science.	5.16	5.29	-0.129	0.658	-2.322*	138	0.022	0.198
I am good at learning new things in science.	5.31	5.38	-0.064	0.691	-1.100	139	0.273	0.101
Being good at science is important.	5.35	5.38	-0.028	0.707	-0.477	140	0.634	0.042
I enjoy science.	5.42	5.43	-0.007	0.643	-0.132	138	0.895	0.016
I want to have a career in science someday.	4.62	4.70	-0.071	0.931	-0.905	140	0.367	0.086
I am proud of my accomplishments in science.	5.35	5.52	-0.171	0.813	-2.495*	139	0.014	0.209
I get bored in science.	2.12	1.92	0.204	1.378	1.736	136	0.085	-0.145
I get angry when I don't understand something in science.	2.45	2.22	0.230	1.112	2.441*	138	0.016	-0.207
I am worried I won't learn all of the things I'm supposed to in science.	2.59	2.31	0.279	1.460	2.258*	139	0.025	-0.192
I get embarrassed in science.	1.60	1.61	-0.007	0.967	-0.087	140	0.931	0.010
SUMMED SCORE	86.51	88.68	-2.165	5.145	-4.743***	126	0.000	0.422

[27] IBM Corp. Released 2019. IBM SPSS Statistics for Windows, Version 26.0. Armonk, NY: IBM Corp.

Table 9. Mixed Between-Within ANOVA: Worry about science learning by gender pre-test to post-test.

Mixed Between-Within ANOVA (time*gender)								
	Female		Male					
	M	*SD*	*M*	*SD*	*F*	*df*	*p*	η^2
Pre-test: I am worried I won't learn all of the things I'm supposed to in science.	2.69	1.481	2.25	1.391	--	--	--	--
Post-test: I am worried I won't learn all of the things I'm supposed to in science.	2.25	1.436	2.38	1.462	4.242*	133	0.041	0.031

Table 10. ANOVA: Worry about science learning by race/ethnicity at pre-test and post-test.

ANOVA											
	Black or African American		Caucasian/ White		Hispanic American		Multiple ethnicity/ other				
	M	*SD*	*M*	*SD*	*M*	*SD*	*M*	*SD*	*F*	*df*	*p*
Pre-test: I am worried I won't learn all of the things I'm supposed to in science.	2.64	1.814	2.36	1.245	2.11	1.132	3.56	1.672	3.838*	3	0.011
Post-test: I am worried I won't learn all of the things I'm supposed to in science.	2.39	1.672	2.10	1.227	2.06	1.259	3.44	1.788	4.292**	3	0.006

Table 11. ANOVA Post Hoc Tukey HSD: Worry about science learning by race/ethnicity at pre-test.

Post Hoc Tukey HSD (Pre-test)			
		MD	*p*
Black or African American	Caucasian/White	0.271	0.854
	Hispanic American	0.525	0.639
	Multiple ethnicity/other	-0.926	0.187
Caucasian/White	Black or African American	-0.271	0.854
	Hispanic American	0.254	0.900
	Multiple ethnicity/other	-1.198*	0.012
Hispanic American	Black or African American	-0.525	0.639
	Caucasian/White	-0.254	0.900
	Multiple ethnicity/other	-1.451*	0.016
Multiple ethnicity/other	Black or African American	0.926	0.187
	Caucasian/White	1.198*	0.012
	Hispanic American	1.451*	0.016

Table 12. ANOVA Post Hoc Tukey HSD: Worry about science learning by race/ethnicity at post-test.

Post Hoc Tukey HSD (Post-test)			
		MD	*p*
Black or African American	Caucasian/White	0.295	0.812
	Hispanic American	0.336	0.870
	Multiple ethnicity/other	-1.046	0.102
Caucasian/White	Black or African American	-0.295	0.812
	Hispanic American	0.040	1.000
	Multiple ethnicity/other	-1.342**	0.004
Hispanic American	Black or African American	-0.336	0.870
	Caucasian/White	-0.040	1.000
	Multiple ethnicity/other	-1.382*	0.023
Multiple ethnicity/other	Black or African American	1.046	0.102
	Caucasian/White	1.342**	0.004
	Hispanic American	1.382*	0.023

Table 13. ANOVA: Confidence in ability to interpret data by race/ethnicity at pre-test and post-test.

ANOVA											
	Black or African American		Caucasian/ White		Hispanic American		Multiple ethnicity/ other				
	M	*SD*	*M*	*SD*	*M*	*SD*	*M*	*SD*	*F*	*df*	*p*
Pre-test: I am able to interpret data in science research.	4.64	0.848	5.18	0.747	5.06	1.197	4.88	0.719	2.590	3	0.056
Post-test: I am able to interpret data in science research.	5.17	1.072	5.29	0.841	5.06	1.305	5.19	0.911	0.316	3	0.814

Table 14. ANOVA Post Hoc Tukey HSD: Confidence in ability to interpret data by race/ethnicity at pre-test.

Post Hoc Tukey HSD (Pre-test)			
		MD	*p*
Black or African American	Caucasian/White	-0.539*	0.042
	Hispanic American	-0.422	0.398
	Multiple ethnicity/other	-0.239	0.819
Caucasian/White	Black or African American	0.539*	0.042
	Hispanic American	0.117	0.954
	Multiple ethnicity/other	0.301	0.558
Hispanic American	Black or African American	0.422	0.398
	Caucasian/White	-0.117	0.954
	Multiple ethnicity/other	0.184	0.921
Multiple ethnicity/other	Black or African American	0.239	0.819
	Caucasian/White	-0.301	0.558
	Hispanic American	-0.184	0.921

Table 15. ANOVA: Summed score of science attitudes and self-efficacy by household income at pre-test and post-test.

ANOVA									
	$0 - $50,000		$50,000 - $99,999		$100,000 and up				
	M	*SD*	*M*	*SD*	*M*	*SD*	*F*	*df*	*p*
Pre-test: SUMMED SCORE	85.46	11.134	86.80	8.421	92.86	6.295	4.324*	2	0.017
Post-test: SUMMED SCORE	88.68	12.29	89.37	8.819	93.95	6.687	1.798	2	0.173

Table 16. ANOVA Post Hoc Tukey HSD: Summed score by household income at pre-test.

Post Hoc Tukey HSD (Pre-test)			
		MD	*p*
$0 - $50,000	$50,000 - $99,999	-1.336	0.854
	$100,000 and up	-7.393*	0.017
$50,000 - $99,999	$0 - $50,000	1.336	0.854
	$100,000 and up	-6.057	0.069
$100,000 and up	$0 - $50,000	7.393*	0.017
	$50,000 - $99,999	6.057	0.069

Table 17. ANOVA: Enjoyment of science by household income at pre-test and post-test.

ANOVA									
	$0 - $50,000		$50,000 - $99,999		$100,000 and up				
	M	*SD*	*M*	*SD*	*M*	*SD*	*F*	*df*	*p*
Pre-test: I enjoy science.	5.53	0.681	5.26	1.095	5.86	0.478	3.219*	2	0.046
Post-test: I enjoy science.	5.48	0.738	5.37	1.079	5.70	0.47	0.926	2	0.401

Table 18. ANOVA Post Hoc Tukey HSD: Enjoyment of science by household income at pre-test.

Post Hoc Tukey HSD (Pre-test)			
		MD	*p*
$0 - $50,000	$50,000 - $99,999	0.274	0.413
	$100,000 and up	-0.324	0.344
$50,000 - $99,999	$0 - $50,000	-0.274	0.413
	$100,000 and up	-0.598*	0.035
$100,000 and up	$0 - $50,000	0.324	0.344
	$50,000 - $99,999	0.598*	0.035

Table 19. ANOVA: Worry about science learning by household income at pre-test and post-test.

ANOVA									
	$0 - $50,000		$50,000 - $99,999		$100,000 and up				
	M	*SD*	*M*	*SD*	*M*	*SD*	*F*	*df*	*p*
Pre-test: I am worried I won't learn all of the things I'm supposed to in science.	2.90	1.566	2.59	1.279	1.76	0.944	4.647*	2	0.013
Post-test: I am worried I won't learn all of the things I'm supposed to in science.	2.40	1.429	2.15	1.199	2.00	1.338	0.586	2	0.559

Table 20. ANOVA Post Hoc Tukey HSD: Worry about science learning by household income at pre-test.

Post Hoc Tukey HSD (Pre-test)			
		MD	*p*
$0 - $50,000	$50,000 - $99,999	0.304	0.667
	$100,000 and up	1.135*	0.010
$50,000 - $99,999	$0 - $50,000	-0.304	0.667
	$100,000 and up	0.831	0.085
$100,000 and up	$0 - $50,000	-1.135*	0.010
	$50,000 - $99,999	-0.831	0.085

Table 21. ANOVA: Embarrassment in science by household income at pre-test and post-test.

ANOVA									
	$0 - $50,000		$50,000 - $99,999		$100,000 and up				
	M	*SD*	*M*	*SD*	*M*	*SD*	*F*	*df*	*p*
Pre-test: I get embarrassed in science.	2.03	1.402	1.48	0.935	1.19	0.402	4.302*	2	0.017
Post-test: I get embarrassed in science.	1.70	1.119	1.37	0.565	1.20	0.41	2.550	2	0.085

Table 22. ANOVA Post Hoc Tukey HSD: Embarrassment in science by household income at pre-test.

Post Hoc Tukey HSD (Pre-test)			
		MD	*p*
$0 - $50,000	$50,000 - $99,999	0.552	0.125
	$100,000 and up	0.843*	0.017
$50,000 - $99,999	$0 - $50,000	-0.552	0.125
	$100,000 and up	0.291	0.610
$100,000 and up	$0 - $50,000	-0.843*	0.017
	$50,000 - $99,999	-0.291	0.610

Table 23. ANOVA: Confidence in ability to ask good questions by household income at pre-test and post-test.

ANOVA									
	$0 - $50,000		$50,000 - $99,999		$100,000 and up				
	M	*SD*	*M*	*SD*	*M*	*SD*	*F*	*df*	*p*
Pre-test: I am able to ask good questions to do science research.	5.07	0.907	4.96	0.898	5.43	0.811	1.776	2	0.176
Post-test: I am able to ask good questions to do science research.	5.03	1.066	5.26	0.712	5.65	0.489	3.336*	2	0.041

Table 24. ANOVA Post Hoc Tukey HSD: Confidence in ability to ask good questions by household income at post-test.

Post Hoc Tukey HSD (Post-test)			
		MD	*p*
$0 - $50,000	$50,000 - $99,999	-0.226	0.561
	$100,000 and up	-0.617*	0.031
$50,000 - $99,999	$0 - $50,000	0.226	0.561
	$100,000 and up	-0.391	0.252
$100,000 and up	$0 - $50,000	0.617*	0.031
	$50,000 - $99,999	0.391	0.252

Table 25. ANOVA: Confidence in ability to analyze data by household income at pre-test and post-test.

ANOVA									
	$0 - $50,000		$50,000 - $99,999		$100,000 and up				
	M	*SD*	*M*	*SD*	*M*	*SD*	*F*	*df*	*p*
Pre-test: I am able to analyze data to do science research.	5.30	0.877	5.22	0.751	5.67	0.658	2.124	2	0.127
Post-test: I am able to analyze data to do science research.	5.40	0.675	5.30	0.669	5.80	0.410	4.144*	2	0.020

Table 26. ANOVA Post Hoc Tukey HSD: Confidence in ability to analyze data by household income at post-test.

Post Hoc Tukey HSD (Post-test)			
		MD	*p*
$0 - $50,000	$50,000 - $99,999	0.104	0.801
	$100,000 and up	-0.400	0.069
$50,000 - $99,999	$0 - $50,000	-0.104	0.801
	$100,000 and up	-0.504*	0.019
$100,000 and up	$0 - $50,000	0.400	0.069
	$50,000 - $99,999	0.504*	0.019

Table 27. ANOVA: Boredom in science by household income at pre-test and post-test.

ANOVA									
	$0 - $50,000		$50,000 - $99,999		$100,000 and up				
	M	*SD*	*M*	*SD*	*M*	*SD*	*F*	*df*	*p*
Pre-test: I get bored in science.	1.90	1.081	2.19	1.302	1.52	0.981	1.991	2	0.144
Post-test: I get bored in science.	1.93	1.252	2.15	1.262	1.26	0.562	3.612*	2	0.032

Table 28. ANOVA Post Hoc Tukey HSD: Boredom in science by household income at post-test.

Post Hoc Tukey HSD (Post-test)			
		MD	*p*
$0 - $50,000	$50,000 - $99,999	-0.217	0.751
	$100,000 and up	0.668	0.116
$50,000 - $99,999	$0 - $50,000	0.217	0.751
	$100,000 and up	0.885*	0.028
$100,000 and up	$0 - $50,000	-0.668	0.116
	$50,000 - $99,999	-0.885*	0.028

Table 29. Mixed Between-Within ANOVA: Confidence in ability to learn new things by household income pre-test to post-test.

Mixed Between-Within ANOVA (time*household income)										
	$0 - $50,000		$50,000 - $99,999		$100,000 and up					
	M	*SD*	*M*	*SD*	*M*	*SD*	*F*	*df*	*p*	η^2
Pre-test: I am able to learn new things in science.	5.5	0.63	5.44	0.751	5.81	0.402	--	--	--	--
Post-test: I am able to learn new things in science.	5.6	0.675	5.78	0.506	5.9	0.308	3.131*	2	0.049	0.078

Table 30. ANOVA: Confidence in ability to learn new things by grade at pre-test and post-test.

ANOVA									
	Grades 4 to 6		Grades 7 to 9		Grades 10 to 12				
	M	*SD*	*M*	*SD*	*M*	*SD*	*F*	*df*	*p*
Pre-test: I am good at learning new things in science.	5.57	0.647	5.41	0.896	5.12	0.969	3.353*	2	0.038
Post-test: I am good at learning new things in science.	5.64	0.543	5.41	1.166	5.21	0.913	2.629	2	0.076

Table 31. ANOVA Post Hoc Tukey HSD: Confidence in ability to learn new things by grade at pre-test.

Post Hoc Tukey HSD (Pre-test)			
		MD	*p*
Grades 4 to 6	Grades 7 to 9	0.162	0.706
	Grades 10 to 12	0.446*	0.038
Grades 7 to 9	Grades 4 to 6	-0.162	0.706
	Grades 10 to 12	0.284	0.258
Grades 10 to 12	Grades 4 to 6	-0.446*	0.038
	Grades 7 to 9	-0.284	0.258

Table 32. ANOVA: Anger from not understanding in science by grade at pre-test and post-test.

ANOVA									
	Grades 4 to 6		Grades 7 to 9		Grades 10 to 12				
	M	*SD*	*M*	*SD*	*M*	*SD*	*F*	*df*	*p*
Pre-test: I get angry when I don't understand something in science.	1.92	1.402	2.68	1.396	2.62	1.187	4.149*	2	0.018
Post-test: I get angry when I don't understand something in science.	1.94	1.286	2.38	1.421	2.36	1.367	1.281	2	0.281

Table 33. ANOVA Post Hoc Tukey HSD: Anger from not understanding in science by grade at pre-test.

Post Hoc Tukey HSD (Pre-test)			
		MD	*p*
Grades 4 to 6	Grades 7 to 9	-0.759*	0.037
	Grades 10 to 12	-0.705*	0.027
Grades 7 to 9	Grades 4 to 6	0.759*	0.037
	Grades 10 to 12	0.054	0.977
Grades 10 to 12	Grades 4 to 6	0.705*	0.027
	Grades 7 to 9	-0.054	0.977

Table 34. ANOVA: Worry about science learning by grade at pre-test and post-test.

ANOVA									
	Grades 4 to 6		Grades 7 to 9		Grades 10 to 12				
	M	*SD*	*M*	*SD*	*M*	*SD*	*F*	*df*	*p*
Pre-test: I am worried I won't learn all of the things I'm supposed to in science.	1.92	1.251	2.57	1.259	2.97	1.576	6.464**	2	0.002
Post-test: I am worried I won't learn all of the things I'm supposed to in science.	2.03	1.424	2.14	1.273	2.60	1.508	2.322	2	0.102

Table 35. ANOVA Post Hoc Tukey HSD: Worry about science learning by grade at pre-test.

Post Hoc Tukey HSD (Pre-test)			
		MD	*p*
Grades 4 to 6	Grades 7 to 9	-0.651	0.126
	Grades 10 to 12	-1.053**	0.001
Grades 7 to 9	Grades 4 to 6	0.651	0.126
	Grades 10 to 12	-0.403	0.351
Grades 10 to 12	Grades 4 to 6	1.053**	0.001
	Grades 7 to 9	0.403	0.351

Appendix B: Student Pre-test Survey Questionnaire with Assent Form

University of New Hampshire

The Joan and James Leitzel Center for Mathematics, Science, and Engineering Education

N117 Parsons Hall
23 Academic Way
Durham, NH 03824

V: 603.862.0718
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www.leitzelcenter.unh.edu

ASSENT FORM FOR STUDENTS

15 MARCH 2019

Dear Student,

We are education researchers at the University of New Hampshire studying how new ways your teacher uses GLOBE in class helps you learn about doing science. You are being asked to participate in this project because your teacher is learning about new ways to teach science.

If you decide to participate, you will allow us to use the surveys that you complete as data in our research study. **Your responses will be grouped with all the student responses we receive to look at how using data in your class helped you understand how to think scientifically. We are not interested in individual answers so your name will not appear with any of our data when we write our reports or present our work to other researchers. When we ask for personal information, it is so that we can keep all of your work together in one file. All of your surveys will receive a code number.**

You don't have to give us permission to use your work if you don't want to. **Your grades in the class will not be affected by your decision, whether you choose to participate or not.** Even if you decide that you want to do it and then change your mind, you can decide to stop at any time. You just need to tell your teacher or email us and we will not use your work.

Your parent/guardian has already given us permission to ask you to participate, so it is up to you.

Sincerely,

Jennifer Bourgeault
U.S. GLOBE Country Coordinator
jen.bourgeault@unh.edu

Haley Wicklein
U.S. GLOBE Office
Haley.Wicklein@unh.edu

My registration code (see nametag) **is** _____

Check one box below:

- ❑ **Yes**, I want to participate in this research project.
- ❑ **No**, I do not want to participate in this research project.

Student – SRS Pre Evaluation

These items ask you to think about how well you are able to do science and how much you like and value science. Please circle the response below that most closely matches your beliefs about science, in particular Earth science. This survey will help us understand how the student research symposium (SRS) is helping students like you learn and become better at science. If you have a question, find an adult and ask him or her to help you. **You do NOT need to write your name on this survey. Please write your registration code here:** _____

Key: 1 = Strongly Disagree 2 = Disagree 3 = Disagree a little 4 = Agree a little 5 = Agree 6 = Strongly Agree	**Circle one response from 1 to 6 for each sentence.**					
1. I am able to learn new things in science.	1	2	3	4	5	6
2. I am able to earn a good grade in my science classes.	1	2	3	4	5	6
3. I am able to ask good questions to do science research.	1	2	3	4	5	6
4. I am able to analyze data to do science research.	1	2	3	4	5	6
5. I am able to interpret data in science research.	1	2	3	4	5	6
6. I am able to construct scientific arguments.	1	2	3	4	5	6
7. I am able to conduct peer review of other students' science research.	1	2	3	4	5	6
8. I am good at science.	1	2	3	4	5	6
9. I am good at learning new things in science.	1	2	3	4	5	6
10. Being good at science is important.	1	2	3	4	5	6
11. I enjoy science.	1	2	3	4	5	6
12. I want to have a career in science someday.	1	2	3	4	5	6
13. I am proud of my accomplishments in science.	1	2	3	4	5	6
14. I get bored in science.	1	2	3	4	5	6
15. I get angry when I don't understand something in science.	1	2	3	4	5	6
16. I am worried I won't learn all of the things I'm supposed to in science.	1	2	3	4	5	6
17. I get embarrassed in science.	1	2	3	4	5	6

Appendix C: Student Post-test Survey Questionnaire

Student – SRS Post Evaluation

These items ask you to think about how well you are able to do science and how much you like and value science. Please circle the response below that most closely matches your beliefs about science, in particular Earth science. This survey will help us understand how the student research symposium (SRS) is helping students like you learn and become better at science. If you have a question, find an adult and ask him or her to help you. **You do NOT need to write your name on this survey. Please write your registration code here:** _____

Key: 1 = Strongly Disagree 2 = Disagree 3 = Disagree a little 4 = Agree a little 5 = Agree 6 = Strongly Agree	Circle one response from 1 to 6 for each sentence.					
1. I am able to learn new things in science.	1	2	3	4	5	6
2. I am able to earn a good grade in my science classes.	1	2	3	4	5	6
3. I am able to ask good questions to do science research.	1	2	3	4	5	6
4. I am able to analyze data to do science research.	1	2	3	4	5	6
5. I am able to interpret data in science research.	1	2	3	4	5	6
6. I am able to construct scientific arguments.	1	2	3	4	5	6
7. I am able to conduct peer review of other students' science research.	1	2	3	4	5	6
8. I am good at science.	1	2	3	4	5	6
9. I am good at learning new things in science.	1	2	3	4	5	6
10. Being good at science is important.	1	2	3	4	5	6
11. I enjoy science.	1	2	3	4	5	6
12. I want to have a career in science someday.	1	2	3	4	5	6
13. I am proud of my accomplishments in science.	1	2	3	4	5	6
14. I get bored in science.	1	2	3	4	5	6
15. I get angry when I don't understand something in science.	1	2	3	4	5	6
16. I am worried I won't learn all of the things I'm supposed to in science.	1	2	3	4	5	6
17. I get embarrassed in science.	1	2	3	4	5	6

Student – SRS Post Evaluation

18. What part of the SRS did you enjoy the most? You may choose more than one.

- ❑ Opening remarks
- ❑ Meeting other students
- ❑ Meeting scientists
- ❑ Keynote speaker
- ❑ Evening activities
- ❑ Research presentations to the reviewers
- ❑ Research presentations to other students
- ❑ Peer review from students
- ❑ Review from scientists
- ❑ Closing ceremony
- ❑ Other activity entitled _____
- ❑ Other activity entitled _____

Why did you choose those events?

19. What part of the SRS did you enjoy the least? You may choose more than one.

- ❑ Opening remarks
- ❑ Meeting other students
- ❑ Meeting scientists
- ❑ Keynote speaker
- ❑ Evening activities
- ❑ Research presentations to the reviewers
- ❑ Research presentations to other students
- ❑ Peer review from students
- ❑ Review from scientists
- ❑ Closing ceremony
- ❑ Other activity entitled _____
- ❑ Other activity entitled _____

Why did you choose those events?

20. Did participating in the research symposium impact your understanding of the scientific process and what it's like to do science research? Explain your answer.

21. Before the student research symposium I thought:

_____

_____

But now I know:

_____

_____

Appendix D: Teacher Post-only Survey Questionnaire

GLOBE Student Research Symposia Evaluation Survey 2019

Dear GLOBE Program Teacher,

We are education researchers from the University of New Hampshire interested in the impact of the professional development on helping teachers and students engage with science practices. We are asking you to participate in a research study investigating the extent to which participation in professional development supports you in the implementation of science practices in your teaching. You were selected as a possible participant because of your interest in the professional development using data from the GLOBE program. We ask that you read this form and ask any questions that you may have before agreeing to be in the study.

The purpose of this study is to understand how participating in the professional development using the GLOBE Program data has influenced your confidence in teaching science practices. We plan to work with approximately 80 teachers in this study. If you agree to be in this study, you agree to allow the questionnaires and activities you complete during the program to be used as data for the study.

There are no known potential risks of participating in this study that would exceed the everyday risks of participating actively in a professional development program. The potential benefits would be insight into how we can better support teachers incorporate science practices into their classrooms. There are no personal benefits to participating in this study. Your responses will be used to advance research and hopefully provide an understanding about how science teaching might be improved. There is no payment for participating in this study. There is no cost to you for participating in this research study.

Participation in this study is strictly voluntary. If you refuse to participate, you will not experience any penalty or negative consequences. It will not affect your current or future relations with the University. You are free to withdraw at any time, for whatever reason. There is no penalty or loss of benefits for not taking part or for stopping your participation.

If you agree to participate, you may refuse to answer any questions posed to you. Also, if you change your mind, you may withdraw at any time during the study without penalty or negative consequences. Participation in this study does not require extra work. Agreeing to participate in this study allows the work you produce and ideas you share to be used as data for research. Declining to participate in this study does not influence your experience in the GLOBE Program.

We seek to maintain the confidentiality of all data and records associated with your participation in this research. There are, however, rare instances when we are required to share personally-identifiable information (e.g., according to policy, contract, regulation). For example, in response to a complaint about the research, officials at the University of New Hampshire, designees of the sponsor(s), and/or regulatory and oversight government agencies may access research data. We are also required by law to report certain information to government and/or law enforcement officials (e.g., child abuse, threatened violence against self or others, communicable diseases). Further, any communication via the Internet poses minimal risk of a breach of confidentiality. While we plan to maintain confidentiality of your responses, other participants may repeat responses outside the program setting. Before the analyses of your work, names will be replaced with codes or pseudonyms to preserve confidentiality. We will keep paper-based data locked in a file cabinet and digital data on a password protected computer; only the researchers in this study will have access to the data. We will report the data mostly in aggregate

form. When individual references to questionnaire responses are reported, pseudonyms will be used to protect the identity of the participants. The results may be used in reports, presentations, and publications. All hard copies and digital copies of your work will be destroyed within 5 years of the start date of this study.

The researchers conducting this study are Jennifer Bourgeault and Haley Wicklein. For questions or more information concerning this research you may contact Jennifer Bourgeault at 603-862-2449 (phone), jen.bourgeault@unh.edu (email) or Haley Wicklein, haley.wicklein@unh.edu. If you have questions about your rights as a research subject, you may contact Dr. Julie Simpson in UNH Research Integrity Services at 603-862-2003 or Julie.Simpson@unh.edu to discuss them.

Statement of Consent: I have read the contents of this consent form and I have received a copy of this form. I have been encouraged to ask questions and I have received answers to my questions. I understand the possible risks and benefits of this study. I know that participating in this study is voluntary. I choose to participate in this study.

Sincerely,

Jennifer Bourgeault
U.S. GLOBE Country Coordinator
Leitzel Center
jen.bourgeault@unh.edu

Haley Wicklein
U.S. GLOBE Office
Leitzel Center
haley.wicklein@unh.edu

I have read the contents of this consent form and I have received a copy of this form. I have been encouraged to ask questions and I have received answers to my questions. I understand the possible risks and benefits of this study. I know that participating in this study is voluntary. I choose to participate in this study.

- ○ Yes, I agree
- ○ No, I do not wish to participate

GLOBE Student Research Symposia Evaluation Survey 2019

Which GLOBE Student Research Symposium did you attend?

- ☐ Midwest (U.S.) Regional Student Research Symposium, University of Northern Iowa, Cedar Falls, IA, 04/05/2019-04/06/2019
- ☐ Pacific (U.S.) Regional Student Research Symposium, NatureBridge, Sausalito, CA 04/26/2019-04/27/2019
- ☐ Northwest (U.S.) Regional Student Research Symposium, Beach Camp, Edmonds, WA, 05/02/2019-05/04/2019
- ☐ Southeast (U.S.) Regional Student Research Symposium, Atlanta Metro State College, Atlanta, GA 05/10/2019-05/11/2019
- ☐ Southwest (U.S.) Regional Student Research Symposium, Mescalero, NM 05/17/2019-05/19/2019
- ☐ Northeast & Mid-Atlantic (U.S.) Regional Student Research Symposium, Boston University, Boston, MA 05/31/2019-06/01/2019

Was this an in-school or out-of-school activity?

- ☐ In-school
- ☐ Out-of-school
- ☐ Other

What subject(s) do you teach? (You can select more than one)

- ☐ Biology
- ☐ Environmental Science
- ☐ Chemistry
- ☐ Physical Science
- ☐ Physics
- ☐ Earth Science
- ☐ General Mathematics
- ☐ Algebra
- ☐ Algebra 2
- ☐ Geometry
- ☐ Pre-Calculus
- ☐ Calculus
- ☐ Computer Science
- ☐ Networking/Robotics
- ☐ Information and Communication Technology
- ☐ Graphic/Media/Web Design
- ☐ Office Applications
- ☐ Other _____
- ☐ My primary content expertise is not related to STEM _____

This section is about your education practices and beliefs.

How often do **your learners** do each of the following in your science classes or programs?

	Never	Rarely (a few times a year)	Sometimes (once or twice a month)	Often (once or twice a week)	Usually (generally they do this but not always)	Always	Does not apply
Generate questions or predictions to explore	○	○	○	○	○	○	○
Identify questions from observations of phenomena	○	○	○	○	○	○	○
Choose variables to investigate (such as in a lab setting)	○	○	○	○	○	○	○
Design or implement their OWN investigations	○	○	○	○	○	○	○
Make and record observations	○	○	○	○	○	○	○
Gather quantitative or qualitative data	○	○	○	○	○	○	○
Organize data into charts or graphs	○	○	○	○	○	○	○
Analyze relationships using charts or graphs	○	○	○	○	○	○	○
Analyze results using basic calculations	○	○	○	○	○	○	○

	Never	Rarely (a few times a year)	Sometimes (once or twice a month)	Often (once or twice a week)	Usually (generally they do this but not always)	Always	Does not apply
Write about what was observed and why it happened	○	○	○	○	○	○	○
Present procedures, data, and conclusions to the class (either informally or in formal presentations)	○	○	○	○	○	○	○
Read from a science textbook or other handouts in class	○	○	○	○	○	○	○
Critically synthesize information from different sources (i.e., text or media)	○	○	○	○	○	○	○
Create a physical model of a scientific phenomenon (like creating a representation of the solar system)	○	○	○	○	○	○	○
Develop a conceptual model based on data or observations	○	○	○	○	○	○	○

GLOBE Student Research Symposia Evaluation Survey 2019

	Never	Rarely (a few times a year)	Sometimes (once or twice a month)	Often (once or twice a week)	Usually (generally they do this but not always)	Always	Does not apply
Use models to predict outcomes	○	○	○	○	○	○	○
Explain the reasoning behind an idea	○	○	○	○	○	○	○
Respectfully critique each others' reasoning	○	○	○	○	○	○	○
Supply evidence to support a claim or explanation	○	○	○	○	○	○	○
Consider alternative explanations	○	○	○	○	○	○	○
Make an argument that supports or refutes a claim	○	○	○	○	○	○	○

GLOBE Student Research Symposia Evaluation Survey 2019

The purpose of this set of questions is to assess your beliefs about educating in the sciences. Please consider each of the items below from your position as a science educator, regardless if you teach in a traditional classroom setting or educate learners in a non-traditional or informal learning environment (e.g., after school program). Please indicate the degree to which you agree or disagree with each statement below.

	Strongly Disagree	Disagree	Slightly Disagree	Slightly Agree	Agree	Strongly Agree	Does not apply
When a learner does better than usual in science, it is often because the educator exerted a little extra effort.	○	○	○	○	○	○	○
I continually find better ways to teach or facilitate science.	○	○	○	○	○	○	○
Even if I try very hard, I do not teach or facilitate science as well as I will most subjects.	○	○	○	○	○	○	○
When the science grades of learners improve, it is often due to their educator having found a more effective approach to teaching or facilitating.	○	○	○	○	○	○	○
I know the steps necessary to teach or facilitate science concepts effectively.	○	○	○	○	○	○	○
I am not very effective in monitoring science experiments.	○	○	○	○	○	○	○

GLOBE Student Research Symposia Evaluation Survey 2019

	Strongly Disagree	Disagree	Slightly Disagree	Slightly Agree	Agree	Strongly Agree	Does not apply
If students are underachieving in science, it is most likely due to ineffective science teaching or facilitating.	○	○	○	○	○	○	○
I generally teach or facilitate science ineffectively.	○	○	○	○	○	○	○
The inadequacy of a learner's science background can be overcome by good teaching or facilitating.	○	○	○	○	○	○	○
The low science achievement of some learners cannot generally be blamed on their educator.	○	○	○	○	○	○	○
When a low-achieving child progresses in science, it is usually due to extra attention given by the educator.	○	○	○	○	○	○	○
I understand science concepts well enough to be an effective teacher or facilitator of science content.	○	○	○	○	○	○	○
Increased effort in science teaching/facilitating produces little change in some learners' science achievement.	○	○	○	○	○	○	○

GLOBE Student Research Symposia Evaluation Survey 2019

	Strongly Disagree	Disagree	Slightly Disagree	Slightly Agree	Agree	Strongly Agree	Does not apply
The educator is generally responsible for the achievement of learners in science.	○	○	○	○	○	○	○
Learners' achievement in science is directly related to their educators' effectiveness in science teaching.	○	○	○	○	○	○	○
If parents comment that their child is showing more interest in science at school, it is probably due to the performance of the child's educator.	○	○	○	○	○	○	○
I find it difficult to explain to learners why science experiments work.	○	○	○	○	○	○	○
I am typically able to answer learners' science questions.	○	○	○	○	○	○	○
I wonder if I have the necessary skills to teach science.	○	○	○	○	○	○	○
Given a choice, I will not invite my principal or superior to evaluate my science teaching/facilitating.	○	○	○	○	○	○	○
When a learner has difficulty understanding a science concept, I am usually at a loss as to how to help the learner understand it.	○	○	○	○	○	○	○

GLOBE Student Research Symposia Evaluation Survey 2019

	Strongly Disagree	Disagree	Slightly Disagree	Slightly Agree	Agree	Strongly Agree	Does not apply
When teaching science, I usually welcome learner questions.	○	○	○	○	○	○	○
I do not know what to do to turn learners on to science.	○	○	○	○	○	○	○

GLOBE Student Research Symposia Evaluation Survey 2019

How much can you do to successfully facilitate the following tasks?

	Cannot do this	Can do little	Can do some	Can do an average amount	Can do a great deal	Can do this	Does not apply
Asking questions	○	○	○	○	○	○	○
Developing models	○	○	○	○	○	○	○
Using models	○	○	○	○	○	○	○
Planning investigations	○	○	○	○	○	○	○
Carrying out investigations	○	○	○	○	○	○	○
Analyzing data	○	○	○	○	○	○	○
Interpreting data	○	○	○	○	○	○	○
Using mathematics	○	○	○	○	○	○	○
Using computational thinking	○	○	○	○	○	○	○
Constructing explanations for science	○	○	○	○	○	○	○
Engaging in arguments based on evidence	○	○	○	○	○	○	○
Obtaining information	○	○	○	○	○	○	○
Evaluating information	○	○	○	○	○	○	○
Communicating information	○	○	○	○	○	○	○

This section is about the resources you used leading up to the SRS.

Which of the following resources did you utilize PRIOR to attending the SRS (you can select as many as you wish)?

- ☐ Consultation/support from your local GLOBE partnership
- ☐ Weekly list serve updates (email)
- ☐ Teacher blog posts
- ☐ Science Practices resource pages (located on internal GLOBE webpages)
- ☐ Teacher Hotline
- ☐ October 9, 2018 Teacher Webinar: Student Research Symposia 2019 Overview with Jennifer Bourgeault, US Country Coordinator
- ☐ February 20, 2019 Teacher Webinar: 'How to Upload Your Data' with Cornell Lewis, GLOBE program web manager

How helpful were the resources you utilized PRIOR to the SRS?

	Not at all helpful	Minimally helpful	Somewhat helpful	Moderately helpful	Helpful	Very Helpful	Does not apply
Consultation/support from your local GLOBE partnership	○	○	○	○	○	○	○
Weekly list serve updates (email)	○	○	○	○	○	○	○
Teacher blog posts	○	○	○	○	○	○	○
Science Practices resource pages (located on internal GLOBE webpages)	○	○	○	○	○	○	○
Teacher Hotline	○	○	○	○	○	○	○
October 9, 2018 Teacher Webinar: SRS 2019 Overview with Jennifer Bourgeault	○	○	○	○	○	○	○
February 20, 2019 Teacher Webinar: 'How to Upload Your Data' with Cornell Lewis	○	○	○	○	○	○	○

GLOBE Student Research Symposia Evaluation Survey 2019

Which of the following resources did YOUR STUDENTS utilize PRIOR to attending the SRS (you can select as many as you wish)?

- ☐ Consultation/support from your local GLOBE partnership
- ☐ Weekly list serve updates (email)
- ☐ Teacher blog posts
- ☐ Science Practices resource pages (located on internal GLOBE webpages)
- ☐ October 9, 2018 Teacher Webinar: Student Research Symposia 2019 Overview with Jennifer Bourgeault, US Country Coordinator
- ☐ February 20, 2019 Teacher Webinar: 'How to Upload Your Data' with Cornell Lewis, GLOBE program web manager

How helpful were the resources YOUR STUDENTS utilized PRIOR to the SRS?

	Not at all helpful	Minimally helpful	Somewhat helpful	Moderately helpful	Helpful	Very Helpful	Does not apply
Consultation/support from your local GLOBE partnership	○	○	○	○	○	○	○
Weekly list serve updates (email)	○	○	○	○	○	○	○
Teacher blog posts	○	○	○	○	○	○	○
Science Practices resource pages (located on internal GLOBE webpages)	○	○	○	○	○	○	○
October 9, 2018 Teacher Webinar: Student Research Symposia 2019 Overview with Jennifer Bourgeault, US Country Coordinator	○	○	○	○	○	○	○
February 20, 2019 Teacher Webinar: 'How to Upload Your Data' with Cornell Lewis, GLOBE program web manager	○	○	○	○	○	○	○

Which of the following resources do you plan to utilize in the FUTURE (you may select as many as you wish)?

- ☐ Consultation/support from your local GLOBE partnership
- ☐ Weekly list serve updates (email)
- ☐ Teacher blog posts
- ☐ Science Practices resource pages (located on internal GLOBE webpages)
- ☐ Teacher Hotline
- ☐ Teacher Webinars

This section is about your experience at the SRS.

Overall, how much satisfaction did you experience with the GLOBE SRS?

	Very dissatisfied	Dissatisfied	Slightly dissatisfied	Slightly satisfied	Satisfied	Very Satisfied
What is your overall level of satisfaction with the SRS **for yourself**?	○	○	○	○	○	○
What is your overall level of satisfaction with the SRS for **your students**?	○	○	○	○	○	○

GLOBE Student Research Symposia Evaluation Survey 2019

How satisfied were you with each of the following components of the SRS experience?

	Very dissatisfied	Dissatisfied	Slightly Dissatisfied	Slightly Satisfied	Satisfied	Very Satisfied	Does not apply
Opening remarks	○	○	○	○	○	○	○
Meeting other teachers	○	○	○	○	○	○	○
Meeting scientists	○	○	○	○	○	○	○
Keynote speaker	○	○	○	○	○	○	○
Evening activities	○	○	○	○	○	○	○
Research presentations to the reviewers	○	○	○	○	○	○	○
Research presentations to other students	○	○	○	○	○	○	○
Peer review from students	○	○	○	○	○	○	○
Review from scientists	○	○	○	○	○	○	○
Closing ceremony	○	○	○	○	○	○	○

Please use this space to provide explanation on your level of satisfaction with your SRS experience for yourself and/or your learners.

Did participating in the SRS improve your ability to integrate science research in your classroom or program?

- ☐ Yes
- ☐ No

Please use this space to explain how SRS improved your ability to integrate science research in your classroom or program.

Please provide any suggestions for improving the SRS objectives, schedule, or setting.

This section is about the professional development you participated in at the SRS.

While at the SRS, did you participate in a professional development activity?

☐ Yes

☐ No *(If no, then you have completed the survey)*

During this SRS professional development activity, how often did you feel...

	Never	Once or twice	Seldom	Sometimes	Most of the time	Always	Not relevant to me
The task was too difficult	○	○	○	○	○	○	○
Interested in the task	○	○	○	○	○	○	○
Eager to learn more about the topic	○	○	○	○	○	○	○
That GLOBE materials presented were useful	○	○	○	○	○	○	○
That GLOBE materials presented were relevant	○	○	○	○	○	○	○
That you will be able to implement what you learned	○	○	○	○	○	○	○
That what you learned will help you be a better educator	○	○	○	○	○	○	○

GLOBE Student Research Symposia Evaluation Survey 2019

During the Teacher Professional Development, which aspect of the workshop did you find the most valuable? Rank the topics below in order of most (1) to least (5) valuable.

_____ Active experience learning the material as a learner
_____ Collaborative PD learning environment
_____ How to find materials on the GLOBE website
_____ Overview of GLOBE Protocols
_____ Discussion of Learning Activities

Please provide any suggestions for how to improve the Professional Development experience.

Appendix E: Other Teacher Survey Results

Classroom or Program Science Practices

Teachers were asked how frequently learners engage in a series of science practices in their classroom or program. Responses were on a scale of 1 'never,' 2 'rarely (a few times a year),' 'sometimes (once or twice a month),' 'often (once or twice a week),' 'usually (generally they do this but not always),' to 5 'always.' (Table 36.) They also had the option to select 'does not apply.' On average, most practices were engaged in 'often,' with the following exceptions:

- At the higher end of the scale, teachers reported that learners 'usually' engaged in making and recording observations (3.86), explaining the reason behind an idea (3.73), writing about what was observed and why it happened (3.71), and gathering quantitative or qualitative data (3.69).
- At the lower end of the scale, teachers reported that learners 'sometimes' engaged in designing and implementing their OWN investigations (2.46) and creating a physical model of a scientific phenomenon (2.38).

Table 36. Frequency of learner engagement in science practices in classrooms or programs as reported by teachers.

Classroom/Program Science Practice	Average Rating	Rounded Scale Point Label
Make and record observations	3.86	Usually
Explain the reasoning behind an idea	3.73	Usually
Write about what was observed and why it happened	3.71	Usually
Gather quantitative or qualitative data	3.69	Usually
Supply evidence to support a claim or explanation	3.67	Usually
Generate questions or predictions to explore	3.49	Often
Identify questions from observations of phenomena	3.33	Often
Organize data into charts or graphs	3.22	Often
Analyze relationships using charts or graphs	3.22	Often
Choose variables to investigate (such as in a lab setting)	3.06	Often
Analyze results using basic calculations	3.00	Often
Critically synthesize information from different sources	3.00	Often
Read from a science textbook or other handouts in class	2.97	Often
Consider alternative explanations	2.95	Often
Make an argument that supports or refutes a claim	2.95	Often
Use models to predict outcomes	2.68	Often
Respectfully critique each other's reasoning	2.62	Often
Develop a conceptual model based on data or observations	2.61	Often
Present procedures, data, and conclusions to the class	2.53	Often
Design or implement their OWN investigations	2.46	Sometimes
Create a physical model of a scientific phenomenon	2.38	Sometimes

Beliefs about Education in the Sciences

Teachers were asked to indicate their agreement on a series of statements regarding beliefs about science education on a scale of 1 'strongly disagree' to 6 'strongly agree.' (Table 37.) They were also given the option to respond, 'does not apply.'

Table 37. Teachers' beliefs about science education.

Statement about Science Education Beliefs	Agree or strongly agree	Slightly agree or slightly disagree	Disagree or strongly disagree
When teaching science, I usually welcome learner questions.	100%	0%	0%
I continually find better ways to teach or facilitate science.	92%	8%	0%
I am typically able to answer learners' science questions.	92%	8%	0%
I understand science concepts well enough to be an effective teacher or facilitator of science content.	89%	11%	0%
I know the steps necessary to teach or facilitate science concepts effectively.	82%	18%	0%
The inadequacy of a learner's science background can be overcome by good teaching or facilitating.	66%	34%	0%
When the science grades of learners improve, it is often due to their educator having found a more effective approach to teaching or facilitating.	62%	32%	5%
If parents comment that their child is showing more interest in science at school, it is probably due to the performance of the child's educator.	49%	46%	5%
When a low-achieving child progresses in science, it is usually due to extra attention given by the educator.	46%	49%	5%
When a learner does better than usual in science, it is often because the educator exerted a little extra effort.	41%	46%	14%
The educator is generally responsible for the achievement of learners in science.	34%	66%	0%
Learners' achievement in science is directly related to their educators' effectiveness in science teaching.	34%	66%	0%
The low science achievement of some learners cannot generally be blamed on their educator.	22%	62%	16%
Increased effort in science teaching/facilitating produces little change in some learners' science achievement.	22%	35%	43%
If students are underachieving in science, it is most likely due to ineffective science teaching or facilitating.	21%	47%	32%
Given a choice, I will not invite my principal or superior to evaluate my science teaching/facilitating.	8%	11%	81%
I wonder if I have the necessary skills to teach science.	8%	16%	76%
I am not very effective in monitoring science experiments.	5%	24%	70%
Even if I try very hard, I do not teach or facilitate science as well as I will most subjects.	3%	17%	80%
I do not know what to do to turn learners on to science.	3%	24%	73%
I generally teach or facilitate science ineffectively.	0%	11%	89%
I find it difficult to explain to learners why science experiments work.	0%	22%	78%
When a learner has difficulty understanding a science concept, I am usually at a loss as to how to help the learner understand it better.	0%	19%	81%

- Teachers most frequently agreed or strongly agreed with the statements, 'when teaching science, I always welcome learner questions' (100%), 'I continually find better ways to teach or facilitate science' (92%), and 'I am typically able to answer learners' science questions' (92%). These statements refer positively to the effort they put into facilitating science learning.
- Teachers most frequently disagreed or strongly disagreed with the statements, 'I generally teach or facilitate science ineffectively' (89%), 'when a learner has difficulty understanding a science concept, I am usually at a loss as to how to help the learner understand it better' (81%), 'given a choice, I will not invite my principal or superior to evaluate my science teaching/facilitating' (81%), and 'even if I try very hard, I do not teach or facilitate science as well as I will most subjects' (80%). These statements refer negatively to their science teaching performance, and the disagree responses indicate a more positive self-assessment.
- Teachers were most uncertain, responding 'slightly agree' or 'slightly disagree,' to the statements 'the educator is generally responsible for the achievement of learners in science' (66%), 'learners' achievement in science is directly related to their educators' effectiveness in science teaching' (66%), and 'the low science achievement of some learners cannot generally be blamed on their educator' (62%). These statements refer to the role of educators in student science achievement, which occurs within a complex system of family, community, and school.

Facilitation of Science Tasks

Teachers were asked about their ability to facilitate a series of science tasks on a scale of 0 'cannot do this,' 1 'can do a little,' 2 'can do some,' 3 'can do an average amount,' 4 'can do a great deal,' and 5 'can do this.' They were also given the option to respond, 'does not apply.' Overall, teachers felt very capable of facilitating the science tasks, with average ratings for all items except one exceeding the 'can do a great deal' mark. Only 'using computational thinking' fell slightly below that mark. Teachers felt most capable at 'communicating information,' 'obtaining information,' 'evaluating information,' and 'engaging in arguments based on evidence,' all of which had average ratings near or above the midpoint between 'can do a great deal' and 'can do this.' (Table 38.)

Table 38. Teachers' ability to facilitate science tasks.

Science Task to Facilitate	Average Rating	Rounded Scale Point Label
Communicating information	4.58	Can do this
Obtaining information	4.53	Can do this
Evaluating information	4.47	Can do a great deal
Engaging in arguments based on evidence	4.45	Can do a great deal
Constructing explanations for science	4.26	Can do a great deal
Planning investigations	4.21	Can do a great deal
Carrying out investigations	4.21	Can do a great deal
Interpreting data	4.11	Can do a great deal
Using models	4.05	Can do a great deal
Developing models	4.03	Can do a great deal
Analyzing data	4.03	Can do a great deal
Using mathematics	4.03	Can do a great deal
Using computational thinking	3.84	Can do a great deal

Appendix F: Supporting Literature

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